JOURNAL

OF THE

Department of Agriculture

OF

WESTERN AUSTRALIA.

Vol. 8. (Second Series) JUNE, 1931. No. 2.

SUGAR BEET AND ITS CULTIVATION.

GEO. L. SUTTON, Director of Agriculture.

The sugar beet has been developed from the ordinary beet—of which the "Mangold" is one form— and its sugar content increased by selection, in order to render it suitable for the manufacture of sugar. It is, therefore, essentially a product for the factory, and the establishment of a factory is necessary for its profitable utilisation. The establishment of a beet sugar factory is, therefore, fundamental to the development of sugar beet farming, and each is necessary and complementary to the other.

Some farmers consider that sugar beet is a good fodder crop admirably suited for the dairy farm. Its cultivation for this purpose, however, is not justified, as its sister plant the "Mangold," "Mangel Wurzel" or "Wurzel," under similar conditions of soil and climate, can be relied upon to produce an equally good stock food at less cost.

Indirectly, however, the production of sugar beet is helpful to the dairy farmer, for after the extraction of the juice from the beets the residue is known as beet pulp, and this is an admirable stock feed. It is specially valuable because of its succulence which it has in common with other root fodders, and, like them, contains a large percentage (90 per cent.) of water.

This crop is, in effect, a garden crop which requires much labour and, in consequence, where the industry is established close settlement is required, and because of its association with a factory requiring large quantities of lime and fuel, it is a valuable complement to a secondary industry employing much labour. There are thus many advantages attached to the sugar beet industry, provided it can be established on economic lines. Consideration of the latter involves attention to three main factors—

(1) The possibility of producing beets of high sugar content;
(2) The cost at which sugar beets can be produced; and
(3) The area of land surrounding a proposed factory site (and suitable in other respects) capable of producing commercially beets of satisfactory quality.

The first factor has already been determined and satisfactorily. In 1920, Plaistowe & Company, Limited, of Perth, interested themselves in this matter, and generously donated £100 as prizes for a sugar beet growing competition. There were 63 entrants in this competition from such widely separated places as Esperance, Southern Cross, Pemberton, and Pintharuka. This indicated great interest and enthusiasm, but also lack of information regarding the requirements of the plant. In consequence, it is not surprising though disappointing, that only five crops were submitted for judging. Some failed, because obviously the climatic conditions were unsuitable, others because the planting was carried out at unsuitable times, or the attention necessary for the cultivation of this intensive crop was lacking.

Whilst the competition was in progress a large number of seed samples were distributed to settlers not entered for the competition. From the resultant crops (including those of the competitors) the judge (Mr. Percy G. Wicken) had samples taken for analyses. He pointed out that, taking the first seven samples, which were grown in Southern and South-West districts, the average (sugar content) was 17.10 per cent., which is above that obtained by the American factories, their average being 16.28 per cent. sugar.

These results were confirmed by those from four experimental plots under the control of the Department of Agriculture, and supervised by Mr. Wicken. He reported that three varieties of sugar beet seed, viz., Vilmorin's "Improved White," "Klein Wanzleben," and "Domestic" were sown, and samples from the resultant crops were taken and submitted for analyses, with the following results:—

Location of Experiment Plot.	Percentage of Sugar.		
	Vilmorin's "Improved White."	"Klein Wanzleben."	"Domestic."
Balingup	20·31	20·13	22·49
Piesse	20·25	20·19	19·45
Capel *	11·76	13·94	14·80
Bridgetown	Failure	...	...

* Stock obtained access to these plots.

It may, therefore, be taken as established that sugar beets of satisfactorily high sugar content can be grown in the Southern and South-Western areas of this State.

Interest in the establishment of the sugar beet industry has revived, and the Harvey Agricultural Society, believing that their district is suitably situated as regards water, fuel, and lime for the establishment of a beet sugar factory, have decided to obtain information regarding the two other fundamental points referred to. With this end in view they have requested, and the Hon. Minister for Agriculture has approved of farmers' trials with sugar beets being conducted in that district under the supervision of an officer of the Department. The prime object of these trials will be to determine the cost per ton of producing commercial sugar beets.

The information regarding the cultivation of this crop in Australia, and especially in West Australia, is meagre, but, fortunately, this crop has received

a great deal of attention by the experiment stations in the United States of America, and, in consequence, there is a wealth of information available for guidance in connection with the methods to secure the best results from the proposed trials.

The sugar beet is a summer growing plant, requiring summer temperatures for the production of sugar. As the result of very extensive experimentation in the United States of America, it has been definitely established that sugar beets can be grown for sugar production in regions which have a mean summer temperature of 70 deg. F., and with ample sunshine to promote sugar formation. In these respects our Southern districts may be regarded as satisfactory, for ample sunshine is undoubtedly available, and for the months of December, January and February the mean temperature at Bunbury, on the coast, and Donnybrook, a few miles inland, is 70 deg. F.

Ample soil moisture is also essential for the production of heavy sugar beet crops. At Maffra, Victoria, where a beet sugar factory has been established, the average annual rainfall is beetween 21 and 22 inches, but of this about half—over 10 inches—falls in the late spring and summer, when the crop is growing. Even with this average summer rainfall it is considered that irrigation is sometimes necessary to secure satisfactory results. In the South-West of this State, though the annual rainfall may range from 30 to 40 inches, only a small percentage falls during the summer months. At Harvey the average annual rainfall is 40.31 inches; of this 6.45 inches falls in the period October to March, inclusive. Only trials, such as are now proposed, can determine whether this limited summer rainfall, not supplemented by irrigation, is sufficient for profitable sugar beet poduction. Because there is some doubt as to whether this amount of summer rainfall is adequate, there is an insistent necessity that the grower shall use the utmost skill, as do our orchardists, in the preparation of the seed-bed and the cultivation of the growing crop, in order that the winter moisture may be conserved and summer evaporation reduced to the minimum.

Sugar beet cannot be grown under pioneering conditions; it is not a plant the seed of which may be sown and then left to take its chance until mature, as with wheat and other hardy cereals. Nor will it grow satisfactorily on all kinds of soils; poor sandy soils are unsuitable, as are also wet and cold ones. No particular soil is absolutely necessary, but it should be fertile and easy to work. The commercial sugar beet desired by the factory is a slender cone-shaped root, with a long single taproot, which extends over 12 inches and sometimes 24 inches into the soil. This requires not only a well-worked soil, but also a deep one, otherwise the undesirable chubby, badly-shaped forked roots, with two or more taproots are formed.

The work of the American experiment stations* has shown that the heaviest yields of sugar beets, containing the highest percentage of sugar in the juice, are produced on rather heavy well-drained and fertile clay loams. On the lighter sandier soils the beets will mature earlier, but the yield of both beets and sugar per acre will be less than on the heavier soils. Sugar beets on peaty soils have generally given good yields, but the amount of sugar contained in the juice has been so low as to make their culture unprofitable. Hard clay soils should never be selected for sugar beets; on these soils roots are never able to penetrate deeply, and much of the root grows above the ground. This portion has to be cut away when "topping," occasioning a large loss in the yield of sugar. Heavy yields of

* *Farmers' Cyclopedia of Agriculture.*

sugar beets, and beets of excellent quality, have been obtained from many of the alkali soils of the Western United States. According to the Colorado Station, sugar beets containing a high sugar content and percentage of purity have been grown on soils showing a top encrustation of salts half an inch thick.

A deep well-tilled friable seed-bed is essential for the production of shapely commercial roots. In America the practice advocated is to plough in autumn to a depth of eight or nine inches, following the furrow with a subsoil plough to loosen the soil six or seven inches deeper.

In this State autumn fallowing or winter ploughing is obviously indicated. If late winter ploughing be practised, this should be carried out early enough to allow the ground to become moderately compacted and capillarity restored before the seed is sown. In the early spring the ground should be given such cultivation as is necessary to ensure perfect tilth. It must be emphasised again that this crop is a "garden crop," and that, because of the labour involved during the growth of this crop, "tilth before seeding and not after it" is essential. The plough, the cultivator, the roller and the harrow may be necessary to secure the desirable seed bed. Care to secure tilth prior to seeding will save much subsequent labour.

Sugar beet seed is imported from Europe, the best known varieties being "Klein Wanzleben" and "Vilmorin's Improved," and, for experimentation, either variety may be used with confidence.

The seed is sown in rows ranging from 18 to 28 inches apart. The width between the rows will be governed by the facilities for cultivating between the rows with a horse-drawn implement. For this reason it is anticipated that it will be found convenient to have the rows nearer 28 inches apart than 18. At Maffra, Victoria, the closer row is recommended.

It is essential to get a good stand of plants, and hence liberal seeding is advisable; it is better to use too much seed than too little. One of the unsatisfactory features of the Plaistowe competition already referred to was the tremendous number of "misses" in the rows, largely due to the unsatisfactory, irregular and scanty seeding. In Victoria 12 lbs. per acre has been found sufficient, though in the United States of America from 15 to 18 lbs. is recommended.

Sugar beets are about as exhaustive on the soil as other farm crops, but not more so. As the elements carbon hydrogen and oxygen, of which the sugar is composed, are obtained by the plant from the atmosphere and contain no fertilising ingredients, it follows that the crop would remove nothing from the ground if the tops as cut off were allowed to remain and the beet pulp returned and distributed over the land from which the beets were taken. This, however, is rarely if ever done, and so manuring of some kind is advisable, though the loss of fertility, due to the removal of the heavy crop, is greatly reduced, in most instances, by feeding the tops and pulp to the farm animals. In the trials carried out by the experiment stations in the United States of America,* stable manure applied to the previous crop has given greater satisfaction than the use of any other fertiliser. When applied direct to the crop it is, however, likely to increase the yield, but to lower greatly the sugar content of the juice. Nitrogenous fertilisers, except in combination with phosphoric acid and potash, are to be applied sparingly, for used alone and in large quantities they were found to produce abnormally large beets which were low in sugar content.

---

* *Farmers' Cyclopedia of Agriculture.*

In Western Australia the use of superphosphate is undoubtedly necessary, and on new land, or following clover, may be all that is required, but pending definite information on this point a complete fertiliser rich in potash should be used. Commercial fertilisers should be applied in the spring and worked thoroughly into the ground before the seed is planted.

To ensure uniform distribution of the seed along the rows care is needed if it is hand sown. For large areas special seeders planting several rows at once are available, but for small plots the Planet Junior seed drill or similar implement is useful for sowing one row at a time. The seed should be drilled about ¾in. deep in moist conditions, and not more than 1½in. under dry ones.

It is advisable that the seed should be planted as early in the spring as the seed will germinate readily, and in this State this will probably be during the months of September and October. While it is desirable that the seed be sown early, it is, however, equally desirable that the soil be warm enough to ensure good germination and a rapid growth of the young plants. If the seeds germinate when the ground is cold the young plants, like a young animal, may receive a "set back," from which they will never recover.

If the ground has been rolled just prior to and for the purpose of facilitating seeding a light harrowing after seeding may be advisable, particularly if the weather is dry, in order to mulch the surface and check evaporation. The harrowing, however, should be light enough as not to disturb the seed which should have been pressed into the firm soil.

Cultivation between the rows should commence as soon as the beets are through the ground, and so define the rows. The object of this inter-tillage is to keep down the weeds and to minimise evaporation. Some may question this latter, as it is obvious that the cultivated surface soil rapidly dries out; but the fact is that the soil moisture cannot readily pass through this layer of dry soil which acts as a blanket to prevent the loss of moisture (by capillarity) from below. In other words, the moisture in the first few surface inches is deliberately lost in order to protect the moisture in the feet below it.

The inter-tillage should be continued throughout the growing season whenever there are weeds to be destroyed, or when the loose dry mulch has been destroyed by rain, care being taken to see that the inter-tillage is not done when the ground is wet enough to be puddled by the passage of the horse and implement over it. The inter-tillage should be shallow and frequent. At first it should be level, but the later cultivations should throw the soil lightly towards the roots, as the portion above the ground has a low sugar content, and is cut off in topping the beets after harvest.

Since each seed ball contains several seeds and usually produces several plants, it is necessary to thin out the young beet seedlings. Hand labour is necessary for this, using narrow hoes for the purpose. With rows about 18 inches apart, thinning is carried out so as to leave individual plants about eight inches apart, but, as it has been found that best yields are obtained when individual beets have from 144 to 160 square inches feeding area, it is recommended that with a greater width between the rows, say 28 inches, the spacing between individual plants in the rows should be closer, say six inches, the object being to produce roots averaging between one to two lbs. rather than heavier ones, as the sugar content of large beets is less than that of the smaller ones.

Thinning should be carried out so as to provide for—

(a) the selection of the strongest beets;

(b) their even distribution in the rows; and

(c) the destruction of all weeds in the rows and immediately around the beets.

Thinning was stated by Easterby, the Manager of the Maffra Factory, to be, without exception, the most important act in beet cultivation. The following is an outline of the process as described by him:—

> "With a sharp four to five inch hoe cut out the young plants so as to leave a two-inch bunch of beets standing every four to five inches. Immediately behind the spacer with the hoe, come the thinners, who should pull out all beets left in the bunch, except the healthiest and strongest plant. This should be done by gently pressing the fingers around the chosen beet while pulling out the others, taking care that the roots are pulled out as well as the leaves, otherwise they would grow again. The earth should be carefully but firmly pressed around the plant that is left, and any weeds in the row should at the same time be eliminated. The thinner should then pass to the next bunch. Great care should be exercised that no double plants are left. The distance left between the plants should, as nearly as possible, be eight inches, only varying this distance when a stronger or better beet is found at a slightly differing distance. In practice this work is quickly done, and the above rules are not altogether adhered to, thinners often providing themselves with different shaped knives adapted to cutting out or selecting beets. The spacing with the hoe, however, is a great advantage, and makes the work of pulling easier. It also helps to get rid of weeds where these exist. Hand weeding should be done up to the part of the row where the horse cultivators have gone. A field of thinned beets has a very wilted and woebegone appearance for a day or two and might give a novice the idea that all the beet had been killed. The disturbed plants quickly take hold again, and, if the season is good and cultivation well looked after, it is really surprising the amount of growth that takes place within the few weeks following thinning."

Sugar beets are ready to harvest when the outside leaves have a yellowish tinge and drop to the ground. The more mature the beets are before being pulled the greater will be the sugar content. The previous trials indicate that the harvesting season will commence at the beginning of March, and may extend to the end of April. The American experience* is that the roots may remain for a considerable time after ripening in the ground without injury. Freezing does not harm them provided they are kept frozen, but freezing and thawing is very injurious. If autumn rains occur while beets are in the ground they are likely to make a second growth, and this causes a decrease in the sugar content. At the Nebraska and Indiana Stations it was found that the second growth was prevented by loosening the roots in the ground sufficiently to break them. This practice had a favourable effect on the sugar content and the percentage purity of the juice. When this is not done the beets should be harvested and stored before the autumn rains come.

For harvesting the beets, Easterby considered that, "apart from machines specially built for harvesting beet roots—none of which is as yet an unqualified success—the best implement for lifting beet roots is the ordinary 'Oliver' or

* *Farmers' Cyclopedia of Agriculture.*

similar plough, deprived of its mould board. This plough runs along the rows with its share under the beet, which it so loosens that they can be easily pulled out by hand and thrown into heaps ready for topping. Topping the beet consists of removing the leaves and collar with one blow from a large knife so that the entire portion upon which leaves have grown shall be cut off. When the ground has been properly subsoiled the roots have plenty of room to grow downwards, but, if shallow ploughing has been done, the roots are forced up by the hard pan beneath and the portion required to be removed is much longer, and consequently the loss is greater from a commercial standpoint."

The yields range up to 30 tons per acre. A good average yield is 11 to 12 tons.

There is a considerable variation in the price obtained by the farmer for topped sugar beets. Mr. P. G. Wicken, in his report dealing with the Plaistowe Cmopetition, stated that at Maffra the price per ton had ranged from 16s. in 1910-11 to 27s. 6d. in 1919, and the average American price at that time (1921) was 7.39 dollars, equivalent at par rates to £1 10s. 9½d. Since then the price has improved considerably. In a letter dated 8th December, 1930, dealing with this and other cognate matters, Mr. Williams, the present manager of the sugar factory at Maffra, points out—

> "The average yield of clean topped beet per acre ranges between 11 and 12 tons.
>
> "The quantity of beet required for 1 ton of sugar varies with the sugar content, but ranges from 7 to 8 tons.
>
> "The cost per ton varies largely according to sugar content and turnover, as the overhead expenses such as repairs, interest and depreciation are fairly constant. Beets will cost £15 to £17 per ton of sugar; interest and depreciation may cost £3 per ton of sugar; manufacture and repairs, £10 to £15 per ton of sugar, according to sugar content and turnover.
>
> "The price of beets in 1929 at the factory was 44s. a ton; from most of the sidings the freight is only 1s. 1d. to 2s. per ton."

In connection with the sugar beet industry Mr. Williams, in another letter dated the 17th December, 1930, stated: "The industry is a splendid one for the employment of labour in the country, and is a profitable crop to grow under present conditions. The difficulty at present is an economic one—Queensland is producing far more sugar than Australia requires and is, therefore, exporting large quantities at a loss, so that the further expansion of sugar production is increasing this difficulty."

The conditions* affecting the establishment of a factory (capacity say, 300 tons beet per day) in any neighbourhood, after it has been proved by trials that sugar beets of satisfactory quality can be grown are—

(1) suitable transportation facilities for both the raw beets and the refined sugar;
(2) a guarantee of the annual production of a sufficient quantity of beets (say, 21,000 tons from 2,000 acres) to keep a factory working to its capacity during the harvesting season;
(3) an abundant supply of good water;
(4) a daily supply of 50 tons of coal, or its equivalent in wood and 20 tons limestone;
(5) competent labour at reasonable rates;
(6) economic methods for handling the pulp, either by feeding to stock or preparing for market.

* *Farmers' Cyclopedia of Agriculture.*

REGISTRATION OF BEES.

All persons keeping one or more hives of bees are required by "The Bees Act, 1930," to register as an apiary with the Department of Agriculture.

If the bees are kept in separate apiaries, each apiary must be registered.

Any person or persons allowing another person to keep bees upon their property are responsible to see that such bees are registered either by the owner or by themselves.

The fees for registration are one shilling for from one to ten colonies, and half-a-crown for over ten colonies.

Application should be made at once to the Department of Agriculture for registration forms.

Defaulters are liable to a penalty of Five pounds.

TRIALS WITH SANTA FÉ LUCERNE.

MERREDIN EXPERIMENT FARM.

E. J. LIMBOURN, Cereal Breeder.

Seed of a variety of lucerne known as "Santa Fé," which originated in the Argentine, was supplied to the Department of Agriculture. Portion of this seed was forwarded to the Merredin Experiment Farm for trials under our wheat belt conditions.

It was planted alongside the standard variety, "Hunter River," on 14th May, 1929, and germinated readily, being well up by 22nd May.

Both varieties received an equal dressing of superphosphate at seeding time, and were hand cultivated and kept free of weeds during growth.

Very little growth was made until after the rains early in November, but the "Hunter River" was decidedly the better of the two throughout the season. Both varieties were cut on 5th December, with the following results:—

	Average Height.	Green Weight.
Santa Fé	14 inches ...	1 lb. 14⅜ ozs.
Hunter River	18 „ ...	2 lb. 12½ ozs.

In the following year two cuts were made, the first on 16th April, 1930, and the second on 1st September, 1930, the results being as follow:—

	Average Height.	Green Weight.
First cut, 16th April, 1930—		
Santa Fé	8 inches ...	¾ lb.
Hunter River	12 „ ...	1½ lb.
Second cut, 1st September, 1930—		
Santa Fé	18 inches ...	14½ lb.
Hunter River	24 „ ...	15½ lb.

After the cutting in September practically no further growth was made by either variety, owing to the absence of rain after that date.

From the observations, extending over two years, upon the growth of the "Santa Fé" lucerne under conditions prevailing in the wheat belt, it is not anticipated that this variety will replace the standard variety "Hunter River," which not only produced a greater weight of greenstuff, but also came away much quicker after the first early rains.

FALLOW COMPETITION.

PHILLIPS RIVER AGRICULTURAL SOCIETY.

Judge: A. S. WILD, B.Sc. (Agric.), Agricultural Adviser.

The 50-acre Fallow Competition conducted by the Phillips River Agricultural Society comprised two sections, making provision for heavy and light land respectively. Nine fallows in the heavy land section, and three in the light land section were inspected, the awards being as follow :—

PHILLIPS RIVER FALLOW COMPETITION.

Judge: A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

Competitor.	Moisture, 40 pts.	Mulch, 10 pts.	Freedom from Weeds, 10 pts.	Consolidation of Seed Bed, 20 pts.	Uniformity of Preparation, 20 pts.	Total, 100 pts.
Heavy Land.						
E. Shinner	37	9	8	17	19	90
J. McCullock	38	9	8	16	18	89
J. W. Love	35	8	9	17	18	87
E. Newton	33	7	9	18	18	85
Chambers Bros.	34	7	7	18	18	84
C. G. Mitchell	35	8	7	17	17	84
Barrett Bros.	33	8	7	17	17	82
I. J. Chapman	30	8	9	16	18	81
S. C. B. Dasborough	25	6	7	16	16	70
Light Land.						
W. H. Smith	36	8	8	19	17	88
W. E. Reynolds	35	7	7	16	17	82
Bebbington Bros.	33	7	8	16	17	81

The detailed cultural methods employed by the competitors are shown here under :—

CULTURAL DETAILS.

HEAVY LAND.

Competitor.	Timber.	Ploughed.	Type of Plough.	Depth of Ploughing.	Condition of Land at Ploughing.	Other Cultivations.
				inches.		
E. Shinner ...	Gimlet and mallee	July	Mouldboard	4	Good	Springtyne cultivated end of August and portion again early in September.
J. McCullock ...	Mallee ...	July	Mouldboard	4	Good	Springtyne cultivated early August.
J. W. Love ...	Salmon gum and mallee	July	Mouldboard	4	Fair	Springtyne cultivated twice in August and twice in September; half was disced ploughed to the full depth of 4in. at the end of September.
Chambers Bros.	Salmon, gimlet and mallee	Early July	Mouldboard	4	Good	Springtyne cultivated in August
C. G. Mitchell ...	Black mallee	Early July	Disc	5	Wet	Springtyne cultivated twice in September.
Barrett Bros. ...	Gimlet, salmon and mallee	Late June	Disc	4	Wet	Springtyne cultivated in August.
I. J. Chapman...	Mallee and gimlet	Late July	Mouldboard	3½	Good	
S. C. B. Dasborough	Salmon, gimlet and mallee	Early August	Disc	2	Hard	

LIGHT LAND.

W. H. Smith ...	Scrub-plain—odd sheoaks	Early July	Disc	4	Excellent	Disced 2in. deep in August.
W. E. Reynolds	Mallee sand-plain	July	Disc	4	Good	
Bebbington Bros.	Mallee ...	Early July	Mouldboard	3½	Wet	Springtyne cultivated early October.

The following table shows the monthly rainfalls as recorded at Ravensthorpe from June, 1930, to February, 1931.

	1930.							1931.		
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Total, June to Feb.
Ravensthorpe ...	163	149	135	76	55	42	15	8	26	669

The rainfall diminished after the end of August and consequently it was difficult to work the fallows satisfactorily after this month. Considering this fact, most of the fallows inspected were of a reasonably good standard.

The entry of Mr. E. Shinner was placed first in the heavy land section, with a total of 90 points. This was a good fallow which showed thorough workmanship. During the previous July it had been ploughed, with a mouldboard plough, to a depth of four inches. Towards the end of August the land was springtyne cultivated, this cultivation being repeated over a portion in order to eradicate thistles. The mulch was comparatively good and the moisture content high.

Mr. J. M. McCullock's competing area had received working similar to that of Mr. Shinner's. The mulch was good except where patches had ploughed up rather cloddy. The moisture content was also comparatively high, being at a depth of about eight inches below the surface. This fallow, however, lost points owing to insufficient consolidation.

Mr. J. W. Love's entry was placed third. The first springtyne cultivation was to the full depth of the ploughing whilst the succeeding three were to a lesser depth. After receiving the fourth cultivation half of the fifty-acre plot was disced to a depth of four inches in order to deal with weeds. This destroyed the mulch and consolidation, and probably affected the moisture content, which was considerably below that of the remaining portion. The portion which had not received the final disc ploughing was the outstanding fallow inspected, having a high moisture content, a well consolidated seed bed, a good mulch and little or no weed growth.

In the light land section Mr. W. H. Smith's entry was awarded first place. The soil was a loamy sand, the location being on a river flat. The fallow had but little weed growth and the consolidation of the seed bed was good. In places the mulch was a little too rough.

If better spring rains had fallen no doubt the fallows in the Phillips River competition would have received further cultivation. Most of the competitors contrived to plough not later than July, the mouldboard plough being more generally favoured than the disc implement. The importance of early and thorough ploughing for most types of soil should be particularly emphasised. Continued experiments at the experiment farms have shown repeatedly the value of early over late fallow—the value of thoroughness is self-evident.

50-ACRE FALLOW COMPETITIONS, 1930.

Judge—G. L. THROSSELL, Dipl. Agric., Agricultural Adviser.

Fallow competitions were conducted during the past season by the Nungarin, Merredin, and Bruce Rock Agricultural Societies and were judged towards the end of January of this year. A falling-off in the number of entries was noticed, this being due to the unsettled state of the industry rather than to a decline in the appreciation of fallow competitions. Those competitors who did participate are to be commended for their keenness despite the unfavourable economic conditions which are disturbing wheat farmers.

All the competitions were judged under the same scale of points, viz.:—

Moisture	40 pts.
Condition of mulch	10 „
Freedom from weeds	10 „
Consolidation of seed bed	20 „
Uniformity of preparation	20 „

NUNGARIN FALLOW COMPETITION, 1930.

Six entries were received for this competition and three entries were submitted for judging—ten less than in the previous competition.

The rainfall recorded at Mukinbudin and Nungarin from June to December was as follows:—

	Fallowing Rains.				Spring Rains.			Summer Rains.			Total, May–Dec.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Total.	
Nungarin ...	324	196	155	675	80	21	101	1	101	102	878
Mukinbudin ...	397	142	174	713	128	16	144	5	66	71	928

The points awarded are shown in the following table:—

NUNGARIN AGRICULTURAL SOCIETY.

50 ACRE FALLOW COMPETITION, 1930.

Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.

Competitor.	District.	Moisture. 40 pts.	Condition of Mulch. 10 pts.	Absence of Weeds. 10 pts.	Consolidation of Seed Bed. 20 pts.	Uniformity of Preparation. 20 pts.	Total. 100 pts.
Creagh Bros., Ltd.. .	Kwelkan ...	83	8	8	18	18	90
Williams, F. A. ...	Mangowine ...	37	7	7	19	18	88
Duthie, W. ...	Mukinbudin ...	36	7	7	18	18	86

The competition was won by Creagh Bros., of Kwelkan, with an entry which was awarded 90 points. The land originally carried salmon gum, gimlet and yorrel, portion of which was cleared in 1914 and the balance in 1921. This paddock is worked on a two-year rotation, viz., fallow-wheat. The entry was early fallow, being ploughed 3-4 inches deep with a disc plough at the end of June and early July. Sheep were run on the fallow during the remainder of the winter to keep the weeds in check. In September it was cultivated with a rigid tyne scarifier. The mulch was in a good condition and of uniform depth, excepting in places where the soil had been rather wet when ploughed and at the time of inspection was rather cloddy. This entry scored well for moisture content and, excepting for a little barley grass which had seeded, was free of weeds. These farmers have been consistent supporters of fallow and other competitions since their inception and this is the first occasion on which they have been successful in winning a fallow competition.

The entry of Mr. F. A. Williams, of Mangowine, was placed second, being awarded 88 points. This entry, which consisted of salmon gum and gimlet country, was worked to a depth of 3 inches with a rigid tyne scarifier in June, harrowed in July, and rigid tyne scarified again in August. The harrowing in July caused the mulch to become too fine and shallow. Potato weed (*Solanum cinploretalum*) was much in evidence.

The cultural details of the competitors have been summarised in the following table:—

NUNGARIN AGRICULTURAL SOCIETY.

50 ACRE FALLOW COMPETITION.

Cultural Details.

Competitor.	Timber.	When cleared.	Rotation.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Sheep.	Points awarded. 100.
Creagh Bros., Ltd.	Salmon, gimlet, yorrell	1914 and 1921.	2 years, Fallow Wheat	June-July	Disc	ins 3–4	Wet	Rigid tyne scarified in September	Yes	90
Williams, F. A.	Salmon, gimlet	1912	2 years, Fallow Wheat	June	Rigid-tyne scarifier	3	Good	Harrowed July, rigid-tyne scarified and harrowed Aug.	Yes	88
Duthie, W.	Gimlet, mallee and scrub	1923	2 years, Fallow Wheat	June	Disc	4	Good	Springtyne cultivated August	...	86

MERREDIN FALLOW COMPETITION, 1930.

Eight of the eleven entries received for the competition were judged, being four less than in the previous competitions.

The rainfall from June to December was as follows:—

	Fallowing Rains.				Spring Rains.			Summer Rains.			Total, June–Dec.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Total.	
Koonadgin ...	401	203	180	784	84	20	104	4	89	93	981
Ulva	283	247	256	886	91	36	127	...	81	81	1,094
Nangeenan ...	325	177	229	731	81	44	125	4	85	89	945
Nukarni ...	314	182	178	674	43	12	55	...	125	125	854

The awards are shown in the following table:—

50 ACRE FALLOW COMPETITION, 1930.

MERREDIN AGRICULTURAL SOCIETY.

Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.

Competitor.	District.	Moisture. 40 pts.	Condition of Mulch. 10 pts.	Absence of Weeds. 10 pts.	Consolidation of seed-bed. 20 pts.	Uniformity of Preparation. 20 pts.	Total. 100 pts.
Cook, W. T. ...	South Burracoppin	37	8	9	19	19	92
Teasdale, H. W. ...	Totadgin	38	8	8	19	18	91
Rowan, C. H. ...	Totadgin	36	8	8	19	18	89
Clothier, J. H. ...	Totadgin	37	8	7	19	18	89
Smallacombe, T. H.	Nangeenan	36	8	8	18	18	88
Zwar, A. T. ...	Merredin	36	7	8	18	18	87
Lambert, J. B. ...	South Burracoppin	35	7	8	19	18	87
Cockram, W. H. ...	Nukarni	36	7	7	18	17	85

The winner of the competition was Mr. W. T. Cook, of South Burracoppin, whose entry was awarded 92 points. This entry was ploughed with a disc cultivating plough in July, 1930, springtyne cultivated in August, and rigid tyne scarified in September. This was a very uniform piece of fallow, having an even mulch overlying a well consolidated level seed bed.

Mr. H. W. Teasdale's entry was placed second with 91 points. This fallow was prepared by ploughing in June-July with a mouldboard plough, when the ground was in a very wet condition, and consequently it worked up in a very lumpy condition. It was rigid tyne scarified in August and October, and harrowed at the end of October.

The cultural details of the competitors are summarised in the table hereunder:

MERREDIN FALLOW COMPETITION.

CULTURAL DETAILS.

Competitor.	Original timber.	When cleared.	Rotation.	When ploughed.	Implement.	Depth of ploughing.	Condition land.	Subsequent cultivations.	Shown.	Points awarded, 100.
Cook, W. T. ...	Gimlet and mallee	1924	2 year—Fallow, wheat	July	Cultivating disc	inches. 4	Good	Springtyne cultivated Aug. Rigidityne scarified Sept.	No	92
Teasdale, H. W. ...	Gimlet and little salmon	1916	2 year—Fallow, wheat	June–July	Mouldboard	4	Very wet	Rigidityne scarified Aug. and Oct. Harrowed end Oct.	Yes	91
Rowan, C. H. ...	Salmon and gimlet	1918	3 year—Fallow, wheat, pasture	June	Mouldboard	3–4	Good	Rigidityne scarified Aug. ...	Yes	89
Clothier, J. H. ...	Mallee and jam scrub	1916	3 year—Fallow, wheat, pasture	June	Mouldboard	3	Good	Springtyne cultivated Aug	Yes	89
Smallacombe, T. H.	Salmon, gimlet, mallee and jam	1926	2 year—Fallow, wheat	July	Disc.	4	Good	Disc cultivated Sept. ..	Yes	88
Zwar, A. T. ...	Mallee, tea-tree and jam scrub	1925	3 year—Fallow, wheat, pasture	July	Mouldboard	1	Good	Cultivated with combined cultivator drill with harrows attached, Sept.	No	87
Lambert, J. B. ...	Gimlet	1925	2 year—Fallow, wheat	June	Disc cultivating	3–4	Good	Disc cultivated Aug. Rigiditype scarified and harrowed Aug. and Sept.	No	87
Cockram, W. H. ...	Gimlet, jam, mallee, and teatree	1912	3 year—Fallow, wheat, pasture	July	Disc cultivating	4	Good	Disc cultivated Aug. Springtyne cultivated Nov.	...	85

BRUCE ROCK FALLOW COMPETITION, 1930.

Six entries were judged in the Fallow Competition conducted by the Bruce Rock Agricultural Society, the awards being as follows:—

50 Acre Fallow Competition, 1930.

BRUCE ROCK AGRICULTURAL SOCIETY.

Judge: G. L. Throssell, Dipl. Agric., Agricultural Adviser.

Competitor.	District.	Moisture. (40 pts.)	Condition of Mulch. 10 pts.	Absence of Weeds. 10 pts.	Consolidation of Seedbed. 20 pts.	Uniformity of Preparation. 20 pts.	Total. 100 pts.
Brown, S.A.	Bungulluping	38	9	9	19	18	93
Smith, C., & Sons ...	Yarding ...	37	9	9	19	18	92
Schilling, C. E., & N. S.	Bungulluping	37	8	9	19	18	91
Allen Bros.	Central Kumminin	36	8	9	18	18	89
Farrall, F. C., & Sons	Yarding ...	36	8	8	18	17	87
Strange, P.	Yarding ...	35	7	8	18	17	85

The winner was Mr. S. A. Brown, of Bungulluping, his entry being awarded 93 points. The land, which originally carried salmon gum and gimlet, and which was cleared in 1914, was ploughed with a mouldboard implement in June-July, 1930, to a depth of 3 inches. It was rigidtyne scarified at the end of August and early September, and springtyne cultivated at the end of September and early October. This was an attractive piece of fallow, the mulch being of uniform depth and in a desirable tilth.

Messrs. C. Smith and Sons, of Yarding, entered the fallow which was awarded second place. Excepting the winning fallow, which had a slightly better moisture content, there was little between these two competing areas.

The rainfall recorded from June to December was as follows:—

	Winter Rains.				Spring Rains.			Summer Rains.			Total, June-Dec.
	June.	July.	Aug.	Total.	Sept.	Oct.	Total.	Nov.	Dec.	Total.	
Bungulluping ...	299	262	218	779	152	47	199	6	18	24	1,002
Yarding ...	380	252	194	826	121	31	155	...	15	15	996
Cent. Kumminin	367	303	136	806	133	29	162	9	35	44	1,012

The cultural details of the competitors are shown in the accompanying table:—

59 ACRE FALLOW COMPETITION.

BROOK ROCK AGRICULTURAL SOCIETY.

CULTURAL DETAILS.

Competitor.	Timber.	When cleared	Rotation.	When ploughed.	Implement.	Depth.	Condition of land.	Subsequent cultivations.	Sheep.	Points Awarded. 100 points.
Brown, S. A. ...	Salmon and gimlet	1914	2 year Fallow, Wheat	June-July	Mouldboard	3in.	Good	Rigidtyne scarified Aug. Sept.; springtyne cultivated Sept.–Oct.	Yes	93
Smith, C., & Sons ...	Salmon and gimlet	...	... ...	June ...	Disc ...	3in.	Good	Disc cultivated July Aug.; rigidtyne scarified Sept.	Yes	92
Schilling C. E. & N. S.	Salmon and gimlet	1922	2 year Fallow, Wheat	June ...	Mouldboard	3in	Good	Harrowed end of June to kill weeds; skim ploughed with mouldboard early August; springtyne cultivated early September	Yes	91
Allen Bros.	Salmon and gimlet	1927	2 year Fallow, Wheat	2nd June	Disc cultivating	3in.	Good	Springtyne cultivated August ...	Yes	90
Farrell, F. C., & Sons	Salmon, gimlet and morrel	1912 & 1921	2 year Fallow, Wheat, Stubble	June ...	Mouldboard	4in.	Good	Disc cultivated August	Yes	87
Strange, P. A ...	Salmon, gimlet and mallee	1924	Fallow, Wheat, Wheat	June-July	Disc cultivating	3in.–6in.	Patchy	Disc cultivated Sept. October ...	Yes	85

A noticeable feature of the three fallow competition judged this year was that all the competing areas were ploughed during the months of June and July. The time of ploughing is one of the most important factors in connection with the production of maximum wheat yields. This has been clearly demonstrated by experiments conducted, not only at the Merredin Experiment Farm, but also at the other experiment farms. At Merredin, where the land is of a similar nature to that of the Nungarin, Merredin and Bruce Rock districts, namely, salmon gum and gimlet forest country, a time-of-ploughing experiment has been conducted continuously since 1924. The results, shown below, leave no doubt that early June fallow is the best fallow.

Time of Ploughing.	Average Yield per Acre, 1924–29.		Percentage Yield, 1924–29.
	bus.	lb.	per cent.
First week in June	18	46	100
Last week in August	14	55	80
Difference	3	51	20

Last year the experiment was slightly modified, an intermediate plot being included, the times of ploughing being respectively mid-June, mid-July, and mid-August, the results obtained being as follows:—

Time of Ploughing.	Average Yield per Acre, 1930.		Percentage Yield, 1930.
	bus.	lb.	per cent.
Mid-June	28	0	100
Mid-July	22	48	81
Mid-August	20	16	72

The results also show that ploughing should be commenced immediately after seeding has finished, and that as much as possible should be done during the early winter months.

As has been previously pointed out, the type of implement used for ploughing is not so important, provided that the implement used is suited for the purpose, enabling the work to be done thoroughly. On land which has been cleared for some time and which has become compacted, it will be found that the heavier types of ploughs do better work than the lighter cultivating ploughs. Where the heavier implement is used, hard patches are less evident and the mulch is more uniform.

Experiments on salmon gum and gimlet country at the Merredin Experiment Farm indicate that ploughing to a depth of four inches is the most economical. There is also evidence that deeper ploughing is not detrimental on this class of country, providing the subsequent cultivations produce a consolidated seed bed.

As a consequence of the low price prevailing for wheat, it is imperative that working costs should be reduced to a minimum. In this respect the mulching experiment supplies the farmer with information as to the working of the fallow. This experiment, which has been conducted continuously since 1915, shows that the fallow should be given a thorough cultivation in the spring and again prior to seeding. Frequent cultivation after summer rains is not profitable; moreover it is often found that such cultivation "fines up" the mulch too much, with the result that it sets after heavy rains. A cultivation during the summer is necessary only when there has been sufficient rain to cause the mulch to run together or to destroy weed growth.

The correct use of harrows on forest country is not properly understood. Generally speaking, the harrows should not be used on forest country until the autumn months. If used early they make the mulch too fine and flatten the surface, so that in many cases they do more harm than good. The fallow during the summer months should have a corrugated surface and the mulch in such a tilth that the larger clods are the size of an average man's fist. The mulch should also be at least 2-2½ inches deep. It is preferable for the fallow to be a little too cloddy during this period rather than too fine as the former condition can be remedied by the cultivation prior to seeding, whereas the latter is certainly a defect, and more difficult to overcome. If the tilth of the fallow is as it should be, then the use of harrows after the autumn rains is often an advantage, as they enable a large area of the fallow to be covered in a short time and assist in the germination of weeds which can be destroyed by the subsequent cultivation. When harrows have been used, the next working should be done with a tyned implement such as a syringtyne or rigid tyne cultivator. The use of the harrows should be avoided on clay country or soil types which easily run together after rain.

The Potato Weed or Summer Thistle (*Solanum hoplopetalum*) is becoming prevalent on fallows in the Eastern Districts. This weed is a deep-rooting perennial which is of consequence only on fallowed land. It does not grow in direct competition with the crop like many other weeds, but by depleting the moisture in the fallowed land on which it is growing during the summer, it has a harmful effect on the crop, especially in a dry season. There are two ways in which this weed spreads: on the surface by seeds and underground by roots. Its control, therefore, rests in the prevention of the formation of seeds and the destruction of surface growth. This can be done by summer cultivation, preferably with a disc implement. When the weed first makes its appearance in a paddock, it should be grubbed out and not left until it has obtained a strong hold before control methods are employed. There are many places where this weed is only making its appearance, and farmers are advised to take measures for its control while the opportunity presents itself.

A few of the areas inspected had plants of Wild Turnip in evidence. On these fallows and those over which the matured plants of the weed had been seen blowing about, it will be advisable to delay seeding until after the first seeding rains in order that the seeds of this noxious weed might be given a chance to germinate and then be destroyed by cultivation prior to seeding.

HORTICULTURAL NOTES.

Geo. W. Wickens,
Superintendent of Horticulture.

Apples, Pears, Stone Fruits.—At time of writing these notes (25/5/31) the deciduous fruit crop of season 1930/31, with the exception of a few late varieties of apples, is gathered, the major portion sold, and growers are once more examining fruit buds endeavouring to estimate from their appearance what next season's harvest is likely to be. To a number of orchardists the present season has been one of keen disappointment and loss, while to others, more fortunately situated, it has been highly profitable. Thrip was the factor that turned what promised to be a record crop (judging by bud development) in the apple growing districts near the Great Southern Railway line, from Katanning to Albany, into the worst failure experienced for many years. And the bad effect of the pest spread as far west as Dinninup, and portions of Boyup, and did some damage, but to a much less extent, to apple orchards near Bunbury and in the hills near Perth. Contrasting with the failure along the Great Southern line was the heavy crop obtained in the orchards near the south-west line from Boyanup to Pemberton, including the Upper Preston and Upper Capel. In this portion of the State in many orchards there was a greater number of apples on the trees than I have previously seen, but I doubt if the final reckoning will show a record yield, as much of the fruit failed to reach average normal size owing to a long spell of dry weather in the growing period, and the trees being too heavily laden. If the experience gained convinces growers of the necessity for thinning in the heavy cropping years it will not have been without some compensation. Cases and cases, and yet more cases, of "two-inch Cleos" should convince anyone that there is a limit to a tree's capacity, and if anything further is needed "two-inch Nickajacks" should supply it. Orchardists should make a note and paste it in their hats that in the year of heavy crops "thinning" is just as essential as cultivation.

It is fortunate for the State that the apple crop was not a failure in all districts, for it has enabled sellers to keep in touch with buyers overseas and prices obtaining, especially when exchange is taken into consideration, are quite good.

The total quantity of apples shipped from 1st January to 15th May amounted to 442,068 cases, and there are a few thousands still to go. The total shipments of all kinds of fruit for the period mentioned comprised 505,178 cases, and nothing gives a better conception of the failure in the southern districts than the fact that only 32,617 cases were shipped from Albany. The orchardists who use that port usually supply one-third of the total quantity exported in any year, and if thrips had not intervened their quota this season would have easily reached 250,000 cases.

The pear and stone fruit crops were lighter in all districts than the average in recent years, the pears exported only amounting to 16,182 cases.

Grapes.—The Western Australian grape crop suffers less from crop fluctuation than any other kind of fruit (excepting lemons) produced here, and though the quantity of fresh grapes exported is not large when compared with apples, it ranks second on the list, and is remarkably uniform from year to year. For instance, during the last five seasons 38,210 cases were exported in 1927; 41,142 in 1928; 48,683 in 1929; 43,052 in 1930; and 46,444 in 1931, with a few more ex cold store still to be shipped.

Of the varieties used for drying purposes, currants were heavier, while lexias and sultanas were lighter than usual. From the commencement of the season in February of this year to 16th May, in the six dried fruit packing sheds in the Swan and Greenmount districts, the total quantities received and packed were as shown hereunder:—Four of the sheds mentioned have still a quantity of fruit on hand which is now being processed, and there is also a small packing shed at Coolup for which I have not returns, but the figures quoted indicate that the currant crop will be the largest produced in the State up to the present:—

	Received.				Packed.			
	tons.	cwts.	qrs.	lbs.	tons.	cwts.	qrs.	lbs.
Currants	1,724	12	3	7	1,525	16	3	...
Lexias	287	9	3	6	196	10	3	16
Sultanas	183	13	3	...	138	4	2	...
	2,195	16	1	13	1,860	12	...	16

The steady increase in currant production during the past five years is interesting and is as follows:—1,146 tons in 1927; 1,221 tons in 1928; 1,290 tons in 1929; 1,332 tons in 1930; 1,525 tons packed up to the 16th May, 1931, with more on hand now being processed.

The export of this season's dried vine fruits up to the 16th May comprised—1,154 tons of currants and 82 tons of lexias.

Citrus.—The orange crop in Western Australia ranges annually from 200,000 to 260,000 cases—the heaviest crop recorded being in 1923 with 264,160 cases, and the lightest in the past seven years for which returns are available was in 1925—193,346 cases. I believe last season's crop was equal to that quoted for 1923, but definite figures are not yet to hand and I estimate this season's crop at 210,000 cases.

The mandarin crop ranges annually from 12,000 to 20,000 cases, and I estimate this season's crop at 13,000 cases.

As mentioned above, the lemon crop is not subject to big variations from year to year, ranging from 51,000 cases to 59,000 cases. I estimate this season's crop at 58,000 cases.

General.—The low prices obtaining for oranges during last winter, and the quantities that fell off the trees during a short spell of violent weather were no doubt indirectly responsible for carrying over fruit fly to a greater extent than for many years past. If the fruit had been higher in price much greater care would have been exercised in gathering it both from the trees and ground, and infested fruit would then have been seen and destroyed, instead of remaining to carry along the pest. I do not say the above was the only, or even the main, cause of the big carry-over, the primary factor being the comparatively long periods of mild, genial weather, but it certainly contributed to the result and growers of Late Valencias which this year were carried on the trees in quantities until March and April, suffered from losses by fruit fly infestation almost equally with stone fruit growers.

Apple and pear growers will be pleased to know that the whole season has passed without any appearance of Codlin Moth either in fresh orchards or orchards previously infected, and another piece of cheering news is the good results obtained in the work done towards eradication of Apple Scab (*Venturia inequalis*). In Mr. Brealey's orchard at Manjimup no trace of the disease has been seen during the

whole season, and he certainly deserves success, for the work he did was exceedingly thorough. In his case the old saying that misfortunes rarely come singly was well exemplified, for a hailstorm in summer that affected only a very small portion of the district, hit his orchard badly and did considerable damage to the apples. In the Porongorups orchard, where Apple Scab was found last year, only one apple was found affected this year and that was early in the season, so that next year's operations should free this orchard from the disease.

FARMERS' FIELD TRIALS, 1930.

A. S. Wild, B.Sc. (Agric.), Agricultural Adviser.

ON THE PROPERTY OF C. O. TRANTER, PINGRUP.

During 1930 two experiments with wheat, viz., a Wheat Variety Trial and a Rate of Superphosphate Trial were conducted at Pingrup on the property of Mr. C. O. Tranter.

The plots were located about 3½ miles South of Pingrup and were planted on a clay loam, which originally carried blackbutt and boree timber. This had been cleared in 1925, the 1930 crop being the fourth to be grown thereon.

During June, 1929, the land was ploughed with a disc implement to a depth of 3½ inches. This was followed by a springtyne cultivation in September and a harrowing in November, after rain had fallen. Towards the end of March the springtyne cultivation was repeated and the plots finally sown on the 9th and 10th of May by means of a combined cultivator-drill.

Each plot was half an acre in area and duplicated. Those in the Variety Trial were grouped so that a comparison could be made between the later maturing varieties "Yandilla King" and "Nabawa" and also between the early maturing varieties as shown in the table of results. Superphosphate was applied in the Variety Trial at the rate of 112lbs. per acre.

In the Rate of Superphosphate Trial three rates were employed, viz., 150, 75 and 225lbs. per acre respectively. For these plots the variety "Nabawa" was selected.

In both experiments the rate of seed was 45lbs. per acre.

The following table shows the rainfalls as recorded at Pingrup during the year :—

	Useful Rains.													Total for year
	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Total	Nov.	Dec.	
1930 ...	...	13	297	103	186	367	308	81	128	36	1,106	6	53	1,578
Average, 5 years	26	15	173	90	172	236	252	142	164	111	1,077	95	23	1,499

Although the totals for both the growing period and for the whole year are above the average, the rainfall for 1930 might well be deemed unsatisfactory. The rainfalls for the months of August, September and October were all below the respective averages, the total for these three months being only 245 points against the average of 417 points.

The results from both experiments are shown hereunder:—

WHEAT VARIETY TRIAL.

Rate o Seed—45lbs. per acre. Rate of 22 per cent. Superphosphate—112lbs. per acre.
Planted 9th May, 1930.

Variety.	Maturity.	Computed Yields per Acre.		Average Yields per acre.	Percentage Yields per acre.
		Section 1.	Section 2.		
		bus. lbs.	bus. lbs.	bus. lbs.	per cent.
Yandilla King ...	Late	14 48	15 6	14 57	78
Nabawa	Mid-season	15 26	15 38	15 32	82
Gluyas Early ...	Early	17 56	20 10	19 3	100
Merredin	Early	18 4	18 24	18 14	96
Carrabin	Early	16 12	20 26	18 19	96
S.H.J.	Early	15 22	16 38	16 0	84

RATE OF SUPERPHOSPHATE EXPERIMENT.

Variety -Nabawa. Rate of Seed—45lbs. per acre. Planted 10th May, 1930.

Variety.	Computed Yields per Acre.		Average Yields per acre.	Percentage Yields per acre.
	Section 1.	Section 2.		
	bus. lbs.	bus. lbs.	bus. lbs.	per cent.
150 lbs., 22 per cent. Superphosphate	18 52	18 18	18 35	111
75 ,, ,, (Control) ...	17 ...	16 36	16 48	100
225 ,, ,, ,, ...	18 42	18 24	18 33	111

The results from the Variety Trial indicate that during a season of scanty finishing rains such as was experienced in Pingrup during 1930, the early maturing varieties are more satisfactory on heavy land than are the later maturing varieties. Although a late maturing variety when given satisfactory climatic conditions would probably produce the heaviest yield, it is from the midseason and early varieties that we must expect the best results during a year of average rainfall.

In the Pingrup district it would probably be better to reserve the late maturing variety, "Yandilla King," for the light land and plant earlier maturing varieties on the heavy land. Of the early maturing varieties "Gluyas Early" would probably give the most consistent yields.

As in previous years the results of the Superphosphate Trial indicate that the yields are increased by applying quantities of fertiliser in excess of 75lbs. per acre.

WINE-MAKING FOR DOMESTIC PURPOSES.

H. K. Johns, Viticulturist.

This is a short account of methods of wine-making suitable for suburban householders in whose gardens there are often a few trellised vines laden with grapes, a large portion of which are allowed to go to waste. No attempt is here made to explain in detail all the methods and appliances necessary for preparing and making wines on a commercial scale. Only the fundamental processes and principles are discussed with enough detail to enable anybody to process small quantities for domestic use.

I would like to point out that wine for commercial sale purposes must comply with the Food and Drug Regulations, and under these regulations "wine" is defined as being the product solely of the alcoholic fermentation of the juice or must of grapes. The addition of water, sugar of all kinds, glycerine, artificial sweetening substances and colouring matters is prohibited.

One case of grapes will yield approximately three gallons, which can be made with little trouble.

Absolute cleanliness in all vessels in which the grapes are handled and their juice is stored are the main factors of success during and after fermentation.

Only good sound ripe grapes, carefully gathered, should be used. Good wine cannot be expected from unsound grapes affected by diseases such as oidium or black spot, or damaged by insects or birds. Grapes which from any cause are mouldy are undesirable.

After the grapes have been collected, they should be stemmed and the stalk of the bunch discarded. The berries should then be pulped by passing between rollers or by some similar method; small quantities can be mashed by hand or with a perfectly tasteless stick of wood. Care must be taken, however, not to crush the seeds. The crushed marc is then put into a vessel for fermentation to take place. An up-ended cask or keg with the top head removed is convenient, or earthenware open-top pickling jars in sizes from one to ten gallons. Metal, galvanised or tin vessels must not be used, as the tin coating soon disappears by its being attacked by the acids in the wine. The vessel in which ferment takes place should be filled to within six inches of the top. The crushed skins will rise to the top and form a layer or head, which is very liable to acetification, and to prevent this the layer should be submerged at least three times a day, either with the hand or a wooden rammer, thus thoroughly mixing the juice with the floating skins. The fermenting vessels should be kept covered with a clean cloth or hessian.

The length of time the crushed grapes should be allowed to ferment varies approximately from four to six days or longer. The longer the marc is allowed to ferment, the darker will be the colour of the resulting wine and the longer it will take to mature.

Separation of the Juice.

A considerable portion of juice will run off after fermentaion if the crushed grapes are transferred to a drainage cage, or if the vessel in which the ferment has taken place has a tap inserted near the bottom, which will drain and leave only the pulp, seeds and skins. These should then be pressed, and to obtain the best results the pressing should be slow and gradual. If no press is available, a good deal of the liquid can be obtained by squeezing by hand through a piece of hessian. Care

must be taken to remove by straining all seeds and particles of floaters, such as skins and pulp. The juice is then put into storage containers, the size and type of which will depend entirely upon the quantity made. With dry wines it is absolutely essential to have all containers filled right up. If wood storage is used a certain amount of evaporation takes place, which in time creates "ullage," and the containers must therefore be "filled" or "topped up" at least three times a month with a sound similar wine. Do not on any account use a fruity or sweet wine in topping up dry wines. This would tend to cause a secondary ferment.

Containers required to make up to from 10 to 30 gallons.—It would be advisable to have five and ten-gallon kegs, together with some one and two-gallon earthenware jars, demijohn type, so as to enable the using up of surplus wine from "filling up" and to prevent any ullages; small balance to be put in bottles.

To make 10 gallons or under, the wine should all be stored in one and two-gallon jars, together with a few half-gallon flagons.

When storage containers are first filled the liquid will still be fermenting, therefore care must be taken not to bung or cork tightly any one of them until fermentation has ceased. Each vessel should be covered with a clean piece of cloth weighted down with a small flat stone or bung to keep the same in position and allow the carbonic acid gas to escape. In small containers, such as gallon jars or flagons, cork the neck of the bottle with cotton wool. Containers should be stored in a cool place, and not moved or shaken up; in a short period fermentation will have ceased. The method adopted by the amateur to ascertain if this is so is to lower a lighted match slowly through the neck of the jar or bung-hole of cask. If the match is immediately extinguished, carbonic acid gas is present, which is an indication that fermentation still exists; if the match burns brightly, the wine is ready for racking or decanting into clean containers.

Racking.

Racking or decanting is necessary in order to separate the wine from its lees, and the first racking is the most important. Care should be taken that the wine runs off clear from the sediment (lees). If kegs are used, a small syphon hose is the best means of drawing off the clear wine. This procedure, racking, should be carried out at least three times in the first six months, and the wine should be in a good clear condition.

After racking, the containers should be corked or securely bunged and stored in a cool place; bottles to be laid on their sides.

BEE-KEEPING NOTES.

METHODS AND TRANSFERRING.

H. WILLOUGHBY LANCE,
Apiculturist.

On this occasion I propose writing a few notes on my observations whilst on inspection work. As might be expected, I find a great deal of difference in the apparatus and methods of Bee-keepers.

Dealing with apparatus first, I still find quite a number of box hives in some districts which necessitate my giving the owners notice under Section 12 of the Bees Act, to transfer these to hives in which all combs are removable for inspection; the penalty for non-compliance being £20. Then there is the man

that has standard frames and hives, but has neglected to put wire and foundation into the frames, and his expenditure on frames is worse than useless, as the bees have built cross comb, and not one of the frames can be removed. Some men have fitted starters or even full sheets of foundation, but due to the frames not hanging plumb in a level hive, or to the hereditary tendency of many bees to build irregular comb, the expenditure and labour are useless.

Another type of hive that one meets is the home-made one with incorrect bee spacing due to the ignorance of the owner of the habits and methods of bees. In some of these hives the covers or frames are stuck so tight with propolis that they break before they can be removed, or there is so much unnecessary space that there is a extra comb which has to be broken or cut before the cover or frames can be removed. All these cases are liable to a penalty not exceeding £20.

Bee-keepers should remember that the natural working space of the bee is ¼ inch. If the space is less than 3/16th of an inch the bees will fill it up. If it is more than 5/16th of an inch they will probably build comb therein.

In a previous issue of this "Journal" I wrote an article on "Bee Hives;" this has been reprinted in leaflet form and can be obtained free on application to the Department of Agriculture. The article contains particulars and sketches of a home-made hive, including a cover or roof, which is much more serviceable and cheaper than most of those that I see on my travels.

Then the bees themselves—what a difference one finds: Any poultry keeper knows the difference between the hen that lays 15 or 20 eggs and then wants to sit, and the hen which lays all through the season without intermission, yet many men are quite content to have bees that gather a little honey and then swarm; gather a little more honey, then swarm again and so on three or four times during the season, at the end of which there is little more than enough honey for the bees to winter on; whereas for the expenditure of from 7s. 6d. to 21s. he could obtain a good queen from a non-swarming strain and obtain a crop of honey which would more than repay the expenditure on the queen.

A word here about Carniolans. So far experience shows them to be very quiet to handle, good comb builders, and excellent honey gatherers. The first cross of a Carniolan queen with an Italian drone so far showing about as good from the honey point of view when the drone comes from good stock, but generally they do not appear quite so quiet as the pure Carniolan.

As regards management, there are still a number of bee-keepers who stick to 8-frame hives and place a queen excluder on top and a box of sections or shallow frames over. This method induces swarming and small honey crops. A bee-keeper's first object should be to obtain strong hives, boiling over with bees, and not restrict the brood chamber. If the queen is prolific enough to fill two 10-frame brood boxes let her, then, given a good honey flow following, the bees will fill two full depth super boxes on top with honey.

A word with regard to the adding of a second super for honey. As soon as the bees have partially capped the centre three or four frames, the super should be raised and the extra super placed between it and the brood chamber, not on top of the first. It should be remembered that bees fill the top cells with honey first and work downwards. Do not wait until the first super is full before adding the second; make the bees realise that there is plenty of work for them to do and they will work all the harder.

Many small bee-keepers without much experience find it difficult to transfer bees from box hives to frame hives, or from frame hives with a mass of cross combs to new frame hives. For their benefit, I will give hereunder particulars of how best to do this.

The transfer should take place, if possible, while there is honey coming in, but it may be done at any time provided the bees are fed plentifully after the transfer has taken place, with sugar or honey syrup. The easiest way of feeding is to obtain a press top tin, such as is used for honey or golden syrup. Punch a dozen or two small holes in the lid and fill with the syrup.

A quilt made of ticking, sacking, or similar material should be placed over the frames and a hole cut in the centre not larger than the size of the tin. The tin of syrup may now be inverted over the hole: the bees will then suck the syrup through the holes. An empty super or box should then be placed on top to cover the tin and the cover of the hive replaced. At least eight or 10 lbs. of syrup should be given to each hive to enable the bees to build the new combs and lay up a store for breeding.

A syrup may be made for this purpose from sugar, using 10 lbs. sugar, 5 pints water, 1 oz. vinegar, ½ oz. salt. Boil for a few minutes and feed to the bees whilst warm. To make honey syrup, dissolve about 2 parts of honey in 1 part of water. If honey is used, the bee-keeper should be quite certain that this does not come from a hive that may have disease, as honey is the principal carrier of foul brood.

To transfer bees from old box to new hive, take the box hive and place on the ground upside down so that the bottoms of the combs are exposed, place bricks or blocks of wood under one end of box to give a slope: place new hive, fitted with frames and full sheets of foundation, on an empty box so that front edge of floor touches the highest end of box hive: draw body of new hive forward to project over floor about 1½ inches.

Drum sides of box and give a little smoke at lowest end. Bees will then run up highest end of box on to floor of new hive. When nearly all the bees are out the combs of honey can be cut out, some of which should be fed back to the bees after they are in their new hive: the combs of brood should be tied with string into frames and put into centre of new hive.

To transfer bees from hive with cross combs.—The method adopted may be similar to that with box hives, but in this case it will be impossible to cut out the combs of brood, and tie into frames. It should therefore not be adopted unless the hive is very strong with bees and there is a good honey flow.

Another method which may be adopted with both box hives and hives with cross combs, when the above are not suitable or easy, is to place the box or old frame hive on top of a new hive fitted with frames and full sheets of foundation, making sure that the only entrance is through the new hive.

As the brood in the old hive hatches out and honey comes in, the bees will fill the empty cells with honey and force the queen down into the new hive. When upon examination it is found that the queen is in the bottom, or new hive, a queen excluder should be placed over it to prevent her again going to the top box. Four weeks later all brood in the top box will be hatched out, and it may then be removed.

The drawback with this method is the time it takes, as the queen will not be forced down until there is plenty of honey coming in.

TESTS WITH FODDER PLANTS, 1931.

AVONDALE STATE FARM.

A. S. WILD, B.Sc. (Agric.), Agricultural Adviser.

These test rows were planted for the purpose of observing the growth and progress of the various plants under test. The land selected was typical York Gum and Jam country and had been fallowed during August, 1929. Each row was 100 links in length.

The fodders were all planted on the 1st May, superphosphate being applied to the equivalent of 150lbs. per acre.

The monthly rainfalls as recorded at the Farm through the year were as hereunder :—

—	Jan.	Feb.	Mar.	Apl.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Total.
1930 ...	...	5	62	153	44	554	619	258	81	35	...	95	1,906

KIKUYA GRASS.

Roots of this grass were planted, but they failed to strike and consequently were a failure.

NEW ZEALAND LUPINS.

These germinated on the 24th May—the germination being 80 per cent.—and flowered about the 21st September. The New Zealand lupins were not very successful, the plants failing to make healthy and vigorous growth. The maximum height attained was only about 12 inches. Probably the excessively wet condition and the nature of the soil (heavy land) were responsible for this failure.

COMMON BLUE LUPINS.

This variety germinated about the 28th May, the germination being 25 per cent. By the 21st of September they were in flower but the plants had made very poor growth and lacked a healthy green colour, being somewhat yellowed. As with the New Zealand lupins, excessive moisture was probably responsible for this. The plants were still green towards the end of November when the New Zealand variety had completely dried off. The maximum height of the plants, however, was only 15 inches and very few seeds were formed.

TANGIER PEAS.

Germination occurred about 23rd May, the germination being about 66 per cent. Throughout the season they continued to make good healthy vigorous growth. The plants continued green up to the middle of November when they commenced to dry off. A fair number of seed pods were formed, but these were attacked by insects.

SUBTERRANEAN CLOVER VARIETIES.

The germination of the Dwalganup, Daliak, and Boyanup varieties was, in each case, fair, but that of the late variety, Wenigup, was poor. The plants of the last named variety, however, made comparatively good, healthy growth, the foliage being large and succulent.

The mid-season variety, Boyanup, made fair growth, being decidedly better than the Daliak variety and probably better than the Dwalganup variety.

The Dwalganup (very early) variety also made fair growth. This strain appeared to make stem rather than leaf growth but produced a fair amount of burr.

DROOPING FLOWER CLOVER.

The germination of this clover was poor. The plants made healthy growth but were small up to the end of September. Subsequently, however, they developed well and produced abundant flower and seed.

CLUSTER CLOVER.

This clover made slightly better growth than did the Drooping Flower Clover early in the season, but nevertheless the plants were small. Later in the season it progressed well, but was slightly inferior to the Drooping Flower Clover.

PHALARIS MINOR.

Throughout the season this grass continued to make good growth. It produced a reasonable bulk of feed by about September, the height of the plants being about 30 inches. The plants retained their succulence until the middle of November.

NEW ZEALAND LUCERNE (MARLBOROUGH STRAIN).

The germination of this seed was poor. It made healthy early growth but failed to provide any bulk of feed after extremely wet conditions set in. However it proved better than the Hunter River Lucerne.

HUNTER RIVER LUCERNE.

The progress of this variety was similar to that of the New Zealand lucerne, but the growth was slightly inferior. At the end of February, 1931, the plants of both varieties, although sickly, were still green.

SHEEP'S BURNET.

This made very slow growth but maintained an excellent colour throughout the growing season. The plants were about 2½ inches high, but at the end of February, 1931, were still green. This appears to be a promising fodder plant to provide late spring and summer feed.

WALLABY GRASS.

Germination of the seed of this grass occurred on the 1st June and was fair. Although healthy, the plants were comparatively small, being inferior to those of the previous year.

VELDT GRASS.

The Veldt grass made strong healthy growth, growing to a height of approximately two feet. It was still partially green late in February, 1931, and had produced abundant seed. This grass has demonstrated itself as suitable for both the lighter and the heavier types of soils in the Beverley District.

ANNUAL RYE GRASSES.

Wimmera Rye Grass (McDougall strain).
Wimmera Rye Grass (Common strain).
Italian Rye Grass.

All varieties germinated well and made excellent growth. The McDougall strain of Wimmera Rye Grass was probably the best, the growth of the common strain being about equal to that of the Italian Rye Grass. The maturity of these grasses was in the order as set out above.

PERENNIAL RYE GRASS (IRISH STRAIN).

This also germinated well and made good growth. The plants were shorter than those of the annual rye grasses, but were finer and more tufty. The test of this grass indicates a good pasture plant.

PLAGUE OF MICE.

MENACE TO WHEAT-STACKS.

C. J. CRAIG.

METHODS FOR DESTRUCTION.

There is every reason to view with concern reports from various stations along the Transcontinental railway line of the presence of mice in vast numbers. The various methods of combating the pest as practised in Victoria may prove serviceable in case of a similar plague occurring here. It may be mentioned that nearly the whole of Victoria was infested in 1917, and that ducks, turkeys and River Murray fish were not popular as food as they practically lived on mice.

Mice are capable of doing enormous damage. The destructive and expensive plague of that time in Victoria was due in a large measure to delay in taking steps to safeguard stacks of hay and wheat, with the result that millions of mice did damage that was estimated to exceed £200,000. At the wheat stacks at Lascelles 500,000 mice, weighing eight tons, were destroyed in four nights. That was typical of the extent of the plague in almost every wheat district. Mice were killed by the dray-load. Conditions this year are just as favourable for the spreading of the vermin. The surest and least expensive method to avoid a similar plague is to deal immediately with the pests wherever they are present in unusual numbers and to safeguard stacks of wheat and hay.

The adoption of a method for destroying the mice depends largely on where they are. If the food that they are attacking can be shut up or placed beyond their reach the mice can be poisoned with strychnine mixed with flour and placed in suitable vessels, such as saucers. In the open a kerosene-tin half-full of water, having the top cut off and sunk level with the ground makes a very effective trap, when placed where the mice are sheltering or congregating. In many cases such traps will be completely filled in a night. Where the mice are not so plentiful an attractive bait placed on the bottom of the tin (no water being left in the tin) will often catch great numbers. In hay or wheat stacks fumigation is most effective, provided that the stack is not too large.

In many instances, however, fumigation is impracticable, and the adoption of the double-fencing system is preferable. This system is simple and inexpensive, and is the one recommended by the Vermin Branch of the Agricultural Department. A double wall of plain or corrugated iron, about 3ft. in height, should be erected around the stacks and sunk in the ground for about 1ft. The walls should be between 2ft. and 3ft. apart. Ramps of rope or old bags should be placed on the inside of the inner wall, and the outside of the outer wall to enable the mice to

climb over the obstacles. In this way the mice trying to enter the stack for food or trying to leave it for water, enter the space between the two walls, in which they are trapped and may be destroyed.

When mice are plentiful in stacks they usually also infest country homesteads. They can be destroyed by the caustic soda method, or by feeding them poisoned pumpkin seeds, turnips, carrots, or parsnips, to which they are most partial. Mix a little arsenic in water in which caustic soda has been dissolved, and then thoroughly immerse the seeds or vegetables. Then place the poison baits in places frequented by the mice.

Another good method of protecting stacks with iron is as follows :—

Obtain a sufficient number of sheets of plain galvanised iron to surround the stack to be protected, the sheets to be 3ft., 22in. gauge, and bend the edge of the sheets at right angles 6in. from the edge, leaving a balance of flat iron of 2ft. 6in. A trench should be made around the stack about 6in. deep, and the iron should be stood in the trench, with the flange on the top outward from the stack. The sheets should have a lap of 2in. where they join, and a backing of quartering at the joints, the timber being driven into the earth. The iron should be secured to the quartering by screws, and a galvanised screw should be inserted in the horizontal part of the lap. At the corners the flange should be cut, the sheet placed between the remaining length of timber and bent as before described, and a piece of iron bolted on top of the separated flange at those points. When the iron is fixed in position replace the earth. Care should be taken that the iron is not broken when bags are being removed from the stack. A stick should be placed at the corners leaning outward over the iron so that when any mice in the stack go searching for water they will climb the sloping stick, jump over and be unable to get back.

"STINKWORT POISONING"—A FORM OF BRAXY-LIKE DISEASE.

By H. W. BENNETTS, M.V.Sc.

A disease of sheep has been experienced, not uncommonly, in Australia which has been associated with the presence of Stinkwort (*Inula graveolens*) in the flowering stage. The writer has seen no published description of the condition, and the relationship of Stinkwort to the mortalities reported has not been defined. Many stockowners are strongly of the opinion that the deaths are due to the ingestion of this plant.

This condition, in Western Australia, was first reported and investigated in 1929. During this current year further outbreaks have been reported from several localities in the South-Western portion of the State. As a result of investigation, the writer has shown that the losses occurring under the conditions indicated are actually due to braxy-like disease.

Bulletin (1) has described a disease affecting sheep in South Australia which appears to be identical with the braxy-like disease occurring in Western Australia. The writer consulted officers of the Stock Department in South Australia in which State deaths in sheep are often ascribed by stockowners to poisoning by Stinkwort. From information supplied, the opinion is reached that the so-called Stinkwort

poisoning, as seen in South Australia, is probably due to braxy-like disease also. The fact that feeding tests carried out there have failed to demonstrate any toxicity in the plant may be taken as supporting this opinion.

It is proposed to describe the disease as it is found in Western Australia, the description being based on the investigation of two outbreaks which are referred to below.

1.—HISTORY.

(I.) *1929 Outbreak.*—On one property at Kojonup, 47 out of 400 merino weaners died during the period April 23rd to May 12th. They were running on a stubble paddock in which there was a liberal growth of Stinkwort in the flowering stage. The sheep were in only fair condition. Later in the year, no Stinkwort now being present, typical braxy-like disease appeared in a flock of merino ewes which were depastured on the same paddock.

(II.) *1931 Outbreak.*—On a property in the Beverley district 100 out of 800 merino lambs died within seven days from April 5th. The lambs were in forward condition, being almost ready for the market. They had been depastured for three or four weeks, prior to the advent of the trouble, on a paddock which was carrying a good growth of flowering Stinkwort. They had also, for short periods, had access to a paddock of wheat stubble which contained a good quantity of fallen grain.

On this property and on the one visited in 1929, it was apparent that sheep had eaten large quantities of Stinkwort flowers and fruits. In previous seasons this plant had been eaten by sheep without any detrimental effects being produced.

2.—SYMPTOMS.

The clinical appearances are typically those of braxy-like disease. The period between the onset of recognisable symptoms and death is very short. Sheep are usually found dead, generally in the morning. A number, however, have been observed while sick, and both types of symptoms described for braxy-like disease have been noted.

(I.) *Comatose or quiet type.*—The affected animal is restless and excited. It moves about chewing dirt, sticks, etc. The gait is staggering and "knuckling over" is observed. Within a short time the animal lies down, usually with its head turned round to the flank. Breathing becomes shallow and rapid. Frothing at the mouth and grinding of teeth are commonly noted. Loss of consciousness soon occurs and the animal lies stretched out on its side and dies quietly, usually within four hours of being observed sick.

(II.) *Convulsive type.*—This differs from the above in that the affected animal shows more or less continuous "galloping" movements, associated with twitching of muscles, champing of jaws, rolling of eyeballs and, towards the end, marked head retraction (opisthotonos). The majority of animals affected with the disease show evidence of scouring and are somewhat tympanitic ("blow up").

Sheep may linger for up to three days, but this is unusual. Occasionally these typical signs of braxy-like disease are preceded by symptoms which appear to be referable to inflammation of the bowels due to the injury inflicted by the hairs of Stinkwort fruits which have been swallowed. These sheep have a tucked-up appearance, are scouring, and have a tendency to wander somewhat aimlessly or to walk into fences, etc.

3.—POST MORTEM APPEARANCES.

Post mortem examinations were made on seven sheep (3 in 1929 and 4 in 1931) which had just died, or which were killed for investigation. The changes observed are identical with those seen in cases of braxy-like disease, viz., injection (inflammation) of bowels and mesentery, congestion of the kidneys, softness of the liver and distension of the gall bladder. There are small blood spots (petechiae) on the outside of the heart and large haemorrhages beneath the inner lining (sub-endocardial haemorrhages in the ventricles).

In all cases of "Stinkwort poisoning" investigated, an additional finding is the presence of hairs of the pappus of Stinkwort embedded in the inner lining of the fourth stomach and bowels. On opening up the bowels these hairs are sometimes seen to form a veritable feltwork, particularly in the small bowel.

Microscopic examination shows these barbed hairs penetrating the wall of the bowel to varying depths (sometimes almost through to the muscular coat). The injury caused by the hairs produces a degree of inflammation (catarrh of the mucous membrane, haemorrhages and cellular infiltration).

In some cases, notably the Kojonup ones, local bacterial infection had been introduced as a result of the wounds created by the hairs.

The microscopic appearance of the liver and kidney were identical with those seen in braxy-like disease.

4.—CAUSE.

The disease is actually braxy-like disease. This disease has been shown by the writer* to be due to active growth of a soil germ, the "B.L.D. bacillus" (closely allied to *B. welchii*) in the small bowel contents. The organism produces a potent poison, or toxin, in this medium and a condition of toxaemia results from the absorption of toxin from the small bowel. The "B.L.D. bacillus" can only grow actively in the small bowel contents under certain favourable circumstances which it is not necessary to consider here. Braxy-like disease, with the exception of occasional losses which occur on peas, is usually confined to the period during which green feed is available to the sheep. The disease, however, may occur when sheep are on dry feed, including flowering Stinkwort. The fruits ("seeds") of the plant, which develop very soon after it comes into flower, are the cause of the trouble. The injury occasioned by the barbed hairs of the pappus (the feathery attachment to the fruit) provides conditions which enable the "B.L.D. bacillus" to proliferate in the small bowel contents (there does not seem to be any active invasion of the bowel itself by this bacillus).

Stinkwort, then, is a factor which under certain circumstances may induce braxy-like disease; and, in the writer's opinion, in this State at any rate, it is otherwise harmless to stock.

In all seven cases of the disease investigated in the two outbreaks referred to, it was found that there was a great proliferation of the "B.L.D. bacillus" in the contents of the small bowel. In two cases the numbers of these germs present were estimated by direct microscopic count to be 700 million and 100 million per c.c. (the total contents of the small bowel about 150 c.c.). In one of the 1931 cases, which was killed whilst affected with the "convulsive" type of the disease, it

* A full account of braxy-like disease of Western Australia is being published in the Journal of the Council for Scientific and Industrial Research.

was shown that the bowel contents (sterile filtrate) contained the highly potent toxin elaborated by the "B.L.D. bacillus," the absorption of which is the cause of the symptoms noted and death.

The idea of a plant paving the way for a bacterial disease is not a new one. Seddon (3) has given a good example. The continued ingestion of bracken fern leads to an inflammation of the intestines which permits of the development of a fatal bacterial infection. It is fairly generally recognised that the normal bowel exerts a protective action which is to a great extent lost when the organ is injured. Ouchi (2), for example, has shown that certain disease-producing bacteria which are destroyed in their passage through a normal bowel are not so destroyed when the bowel wall has been injured by parasites or chemical irritants, and under these circumstances they may prove fatal to the animal.

Although sheep as a general rule may eat Stinkwort seeds with impunity, when the soil is infected with the "B.L.D. bacillus," and in the presence of certain factors not fully understood, braxy-like disease results.

Evidence at present available indicates, as one would expect from experience with the ordinary type of braxy-like disease, that sheep in good condition are those which are most likely to be affected when grazing on Stinkwort.

5.—CONTROL.

Control measures other than the control of the weed itself, or the removal of sheep from paddocks where the plant is prevalent, do not suggest themselves. The period of danger is short, being practically confined to the months of April and May when the plant is flowering and seeding. Partial starvation may help to check losses.

6.—CONCLUSIONS.

(I.) A disease is described which affects sheep as a result of feeding on Stinkwort in the fruiting stage.

(II.) This condition has been shown to be identical with braxy-like disease. The barbed hairs of the pappus attached to the fruits of Stinkwort injure the bowel wall and provide conditions which are favourable for the growth and toxin production of the causal organism—the "B.L.D. bacillus."

(III.) This form of braxy-like disease was first noticed in this State in 1929. It appears to have occurred in a number of localities during the current year.

LITERATURE CITED.

1. Bull, L. B.—Notes on investigation into some sheep diseases in South Australia. *Rept. Aust. Assoc. Adv. Sci.*, 17 (1924), p. 175.

2. Ouchi, T.—Experimental studies on the destiny of typhoid bacillus introduced per os into dogs. *Sci. Repts. Gov. Inst. Infect. Dis. Tokyo Imp. Univ.* 6 (1927), p. 1.

3. Seddon, H. R.—A review of plants poisonous to live stock. *Rept. Aust. and N.Z. Assoc. Adv. Sci.*, 20 (1930), p. 409.

"THE JOURNAL OF AGRICULTURE"

will be supplied free *on application* to any person in the State who is following Agricultural, Horticultural, or Viticultural pursuits, to Agricultural Societies or Associations, and to any person otherwise interested in Agriculture.

A charge of Threepence per copy will be made for the *Journal* to persons other than the foregoing, or who do not reside in the State. These applications, accompanied by the requisite amount, must be forwarded to the Director of Agriculture, Department of Agriculture, who will also receive all correspondence dealing with the conduct of the *Journal*.

Editors of Agricultural and Country papers are invited to reproduce any of the articles contained in this Journal, providing the usual acknowledgment is made.

If you are not receiving the *Journal*, which is issued quarterly, and wish to do so, please forward your name and postal address to the Director of Agriculture, Perth.

FLAG SMUT OF WHEAT.

VARIETY RESISTANCE TESTS, 1926 TO 1930.

E. J. LIMBOURN, Cereal Breeder.
Merredin Experiment Farm.

The Flag Smut Resistance Tests, conducted at the Merredin Experiment Farm, are carried out in a plot well isolated from the main cropping paddocks in order to minimise, as far as possible, the danger of spreading infection throughout the farm.

In 1930 one hundred seeds of each of the varieties were planted in rows which were 50 links in length and two links apart, the seed being planted half a link apart in the rows. In the previous seasons, however, only 50 seeds were planted in the rows.

Infecting the seed.—A quantity of infected leaves was finely minced in order to get the spores as free as possible. To infect the seed, 100 grains of each variety were mixed with two teaspoonsful of the minced infected leaves, and well shaken up. It was found that the spores adhered very well to the brush end of the grain, and also in the crease.

Planting.—Each row was opened out with a hoe, and a light sprinkling of superphosphate given before dropping the seed. The infected grain was then pressed into the ground with a pinch of the minced infected material, and, before covering in the grain, the row was sprinkled with additional infected material.

Recording infection.—Inspection of the rows was made during the growth of the plants, and any infected plant found, pulled up and destroyed as soon as noticed. At the same time a record was made of the number of such plants in the Field Book. A count was also made of the clean plants at the end of the season, and from these two records the percentage of infection was obtained.

In the accompanying tables the 128 varieties so far tested have been classified in three sections, viz.:—

Resistant—0 to 10 per cent. infection.

Susceptible—11 to 25 per cent. infection.

Very susceptible—over 25 per cent. infection.

For the purpose of this experiment, the susceptibility of a variety is its highest recorded infection during any season in which it may have been tested.

It has been found that varietal infection varies with the time of planting and seasonal conditions. Therefore, to obtain very definite information regarding the susceptibility of a variety, it would be necessary to test such variety over a number of years.

Owing to the necessity for isolation indicated above, the area available for this experiment is limited. The major portion of the plot is also taken up by the plantings of new crossbred types and pure line varieties that are under selection for resistance to the disease.

In order to obtain some indication of the resistance of as many varieties as possible, only such varieties as show fairly high resistance to the disease have so far been tested for more than one season.

Of those included in the resistant section, the following varieties have been tested for two or more years with consistent results:—Baroota Wonder Early, Bencubbin, Bunyip, Carrabin, Confederation, Dindiloa, Exquisite, Florence, Ford, Geeralying, Ghurka, Nabawa, Nolba, Queen Fan, Riverina, S.H.J., Tobys Tusk, Wandilla, and Yetna.

Both Ford and Queen Fan are reported to be fairly susceptible under field conditions, and it is thought that the strain under test may have been improved by constant selection at this farm. Seed from a farmer's crop of each variety infected by Flag Smut has been obtained, and will be tested alongside the Experiment Farm strain during the coming season.

Ten of the *resistant varieties* are crossbred types produced by the Western Australian Department of Agriculture, either at the Chapman or Merredin Experiment Farms. Six of these are obtainable as Pure Pedigree Seed, they are:—Bencubbin, Nabawa, Carrabin, S.H.J., Geeralying, Sutton; the other four varieties being:—Bowes, Dindiloa, Nolba, Yetna.

Baroota Wonder Early is also recommended for hay by the Department of Agriculture, and obtainable as pure pedigree seed.

The susceptible varieties distributed by the Department are now limited to the following four:—Gluyas Early, Merredin, Noongaar, Yandilla King.

These all have other useful characteristics that make it difficult to replace or altogether discard them, but their susceptibility should be considered where the ground to be planted has borne an infected plot in previous seasons.

With the widespread use of the variety Nabawa in this State, it is not surprising that few reports of severe loss from Flag Smut are received.

Still further use of resistant varieties will do much to control the spread of this disease, which in other States is considered a real danger to profitable wheat growing.

FLAG SMUT RESISTANCE TEST, 1926 TO 1930.

Result of Varietal Resistance Test as shown by the percentage of Infection obtained.

Variety.	Reg. No.	1926.	1927.	1928.	1930.	Average.	Highest Infection.
	P.	%	%	%	%	%	%
Alliance ...	1700	...	22	...	...	22	22
Aussie ...	1785	...	22	...	...	22	22
Bald Early ...	986	5	...	...	...	5	5
Baldmin ...	1897	...	...	...	57	57	57
Barcota Wonder	1349	2	...	...	...	2	2
Early Barcota Wonder	859	0	0	1	...	0·3	1
Bena	1614	21	...	...	...	21	21
Bencubbin ...	1987	...	2	2	3	2	3
Bindu	1887	...	...	...	1	1	1
Binya	1789	...	24	...	...	24	24
Bobin	1726	...	10	...	...	10	10
Bomen ...	1506	...	...	...	4	4	4
Boolaroo ...	1727	...	10	...	16	13	16
Boonoo ...	1736	...	3	...	12	7	12
Bowes ...	1804	9	...	...	...	9	9
Bredbo ...	1775	...	9	...	32	20	32
Bruce	1790	...	27	...	...	27	27
Bunyip ...	421	0	0	0	2	0·5	2
Cadia	1728	...	52	...	...	52	52
Caliph ...	914	0	3	20	...	8	20
Canberra ...	709	16	41	...	...	28	41
Canimbla ...	1821	...	10	...	42	26	42
Capitol ...	1698	...	41	...	...	41	41
Carrabin ...	1437	0	1	1	3	1	3
Cargo	1788	...	20	...	...	20	20
Carwarp ...	1835	...	...	...	19	19	19
Cedar	222	...	...	...	1	1	1
Cedric	1456	...	...	...	37	37	37
Clarendon ...	1507	1	...	2	16	6	16
Collin	1900	...	...	...	5	5	5
Comeback ...	228	1	0	9	20	8	20
Confederation...	1696	1	0	7	7	4	7
Coral	1891	...	...	...	8	8	8
Cowhort ...	1938	...	...	...	40	40	40
Currawa ...	522	...	...	...	27	27	27
Currimp ...	1747	...	...	...	16	16	16
Dargum ...	1905	...	...	...	26	26	26
Dindiloa ...	1438	...	...	0	0	0	0
Dollar	1776	...	4	...	49	26	49
Dookie Delta	1744	...	5	...	34	20	34
Drof	1988	...	...	...	78	78	78
Duri	1774	...	8	...	27	18	27
Early Bird ...	1773	...	13	...	...	13	13
Empire ...	1702	...	46	...	...	46	46
Exquisite ...	1739	...	0	0	3	1	3
Federation ...	460	6	27	...	...	16	27
Firbank ...	225	...	...	...	5	5	5
Firwhill ...	1907	...	...	...	5	5	5
Florence ...	223	0	...	2	0	0·7	2
Ford	915	...	...	0	7	4	7
Fortune ...	911	6	...	...	...	6	6
Gallipoli ...	1636	3	12	...	67	27	67
Geeralying ...	1442	0	...	0	0	0	0
Gem	1451	13	...	...	...	13	13
Genoa	1511	...	...	4	42	23	42
Ghurka ...	1713	4	5	9	10	7	10
Gluclub (Vic.)	1754	...	12	...	...	12	12
Gluclub (W.A.)	1787	...	12	...	...	12	12
Gluyas Early...	159	47	61	66	72	61	72
Gluyas Late ...	1337	10	...	...	...	10	10
Golden King ...	1429	...	10	14	...	12	14
Golden Return	1991	...	...	...	54	54	54
Goonoo ...	1904	...	...	...	21	21	21
Gresley ...	1038	2	6	21	...	10	21
Gullen ...	1993	...	...	...	3	3	3
Hard Federation	958	10	...	...	...	10	10
H.B.	1948	...	...	...	2	2	2
Hunter ...	1903	...	...	...	9	9	9
Indoret ...	1750	...	0	7	14	7	14
Indian Pusa 4	1459	...	...	...	16	16	16
Joffre	1875	...	...	...	9	9	9
Joffrette ...	1873	...	...	...	5	5	5
King's White...	1368	...	...	...	20	20	20
Krithia ...	1706	...	7	...	22	15	22
Lawson ...	1902	...	...	...	1	1	1
Lilydale ...	1721	...	...	4	...	4	4
Mahratta ...	1708	...	28	...	...	28	28
Major	1270	2	...	...	...	2	2
Marmora ...	1709	...	37	...	...	37	37
Merredin ...	1440	23	25	...	...	24	25
Minister ...	834	6	...	...	31	19	31
Minyip ...	1746	...	17	...	...	17	17
Mogul	1703	26	...	...	...	26	26
Nabawa ...	1432	0	1	0	1	0·5	1
Nabob ...	1705	...	24	...	...	24	24
Newman's Early	955	4	3	19	...	9	19
Niloc	1277	13	...	...	...	13	13
Nizam ...	1635	6	...	...	29	17	29
Nolba	1800	0	0	0	1	0·25	1
Noongaar ...	1769	6	3	27	...	12	27
Nugget ...	1609	...	34	...	...	34	34
Nungarin ...	1435	...	12	...	...	12	12
Ogilvie ...	1803	17	...	...	...	17	17
Omrah ...	1741	...	29	...	...	29	29
Parsee ...	1701	27	...	...	...	27	27
Patriot ...	1463	...	...	17	...	17	17
Perfection ...	1929	...	...	...	9	9	9
Queen Fan ...	1194	0	0	2	1	1	2
Rajah	1710	1	2	4	11	5	11
Ranee	1697	7	5	27	18	14	27
Red Rock ...	1906	...	...	...	0	0	0
Reward ...	1894	...	...	...	7	7	7
Riverina ...	1786	...	2	4	10	4	10
Roseworthy ...	1190	4	...	...	...	4	4
Rymer ...	1379	...	...	...	0	0	0
Sepoy	1695	...	3	...	17	10	17
S.H.J. ...	1445	0	3	0	5	2	5
Sindhi ...	1901	...	...	...	0	0	0
Sovereign ...	1704	...	3	...	...	3	3
Sterling ...	1712	30	...	...	...	30	30
Stewart ...	1831	...	...	...	0	0	0
Sunset ...	675	...	...	...	0	0	0
Sultan ...	1199	3	...	...	...	3	3
Sutton ...	2028	...	...	...	2	2	2
Suvla	1699	...	17	...	...	17	17
Toby's Tusk ...	920	1	8	6	...	5	8
Turvey ...	257	3	...	...	26	15	26
Union	1777	...	34	...	...	34	34
Viceroy ...	1711	12	...	...	...	12	12
Wandilla ...	1182	0	0	0	3	1	3
Wannon ...	1637	11	...	...	...	11	11
Waratah ...	1627	32	...	40	...	36	40
Wardfir ...	1756	...	3	15	23	10	23
Whillan ...	1841	...	...	...	39	39	39
X.B.	1947	...	...	...	40	40	40
Yandilla ...	392	...	...	...	19	19	19
Yandilla King...	226	0	0	20	...	7	20
Yetna	1801	...	0	1	0	0·3	1

FLAG SMUT RESISTANCE TESTS, 1926 TO 1930.

Varieties arranged according to their percentage of infection, taking the highest percentage of infection shown for any season during the tests :—

RESISTANT VARIETIES.

Highest infection recorded being not more than 10 per cent.

	%		%		%		%
Dindiloa	0	Yetna	1	Sultan	3	Ford	7
Geeralying ...	0	Baroota Wonder ...	2	Wandilla	3	Reward	7
Red Rock ...	0	Bunyip	2	Bomen	4	Coral	8
Rymer	0	Florence	2	Lilydale	4	Toby's Tusk ...	8
Sindhi	0	H.B.	2	Roseworthy ...	4	Bowes	9
Stewart	0	Major	2	Bald Early ...	5	Hunter	9
Sunset	0	Queen Fan ...	2	Collin	5	Joffre	9
Early Baroota Wonder ...	1	Sutton	2	Fibank	5	Perfection ...	9
Bindu	1	Bencubbin ...	3	Firwhill	5	Bobin	10
Cedar	1	Carrabin	3	Joffrette	5	Ghurka	10
Lawson	1	Exquisite	3	S.H.J.	5	Gluyas Late ...	10
Nabawa	1	Gullen	3	Fortune	6	Hard Federation ...	10
Nolba	1	Sovereign	3	Confederation ...	7	Riverina	10

SUSCEPTIBLE VARIETIES.

Highest infection recorded being from 11 per cent. to 25 per cent.

	%		%		%		%
Rajah	11	Golden King ...	14	Suvla	17	Goonoo	21
Wannon	11	Indcret	14	Carwarp	19	Gresley	21
Boonoo	12	Boolaroo	16	Newman's Early ...	19	Alliance	22
Gluclub (Vic.) ...	12	Clarendon ...	16	Yandilla	19	Aussie	22
Gluclub (W.A.) ...	12	Currimp	16	Caliph	20	Krithia	22
Nungarin	12	Indian Pusa 4 ...	16	Cargo	20	Wardfir	23
Viceroy	12	Minyip	17	Comeback ...	20	Binya	24
Early Bird ...	13	Ogilvie	17	King's White ...	20	Nabob	24
Gem	13	Patriot	17	Yandilla King ...	20	Merredin	25
Nilloc	13	Sepoy	17	Bena	21		

VERY SUSCEPTIBLE VARIETIES.

Highest infection recorded being over 25 per cent.

	%		%		%		%
Dargum	26	Mahratta	28	Cedric	37	Genoa	42
Mogul	26	Nizam	29	Marmora	37	Empire	46
Turvey	26	Omrah	29	Whillan	39	Dollar	49
Bruce	27	Sterling	30	Cowhort	40	Cadia	52
Currawa	27	Minister	31	Waratah	40	Golden Return ...	54
Duri	27	Bredbo	32	X.B.	40	Baldmin	57
Federation ...	27	Dookie Delta ...	34	Canberra	41	Gallipoli	67
Noongaar	27	Nugget	34	Capitol	41	Gluyas Early ...	72
Parsee	27	Union	34	Canimbla	42	Drof	78
Ranee	27						

ROYAL AGRICULTURAL SOCIETY—FODDER CROP COMPETITION.

G. K. BARON-HAY, Superintendent of Dairying.

In order to encourage the growing of summer fodders in the dairying districts of the State, the Royal Agricultural Society conducted a special Competition commencing during the Spring of 1930, dividing the State into three Zones, as follows :—

ZONE 1.—Country north of a line running from the coast due east through Dardanup to the Great Southern Railway.

ZONE 2.—A line from the southern boundary of Zone 1, due south through Boyup Brook to the coast. All country west of this line bounded by the coast to be in Zone 2.

ZONE 3.—Districts south of Zone 1 and east of the eastern boundary of Zone 2, embracing the Denmark district.

A First Prize was offered in each Zone—£5 ; and a Second Prize in each Zone—£3. In addition, a Special Prize of £5 was awarded the competitor who produced the highest yield per acre in any Zone, irrespective of other points.

Entries were judged on the following points :—

Yield	50 points.
Freedom from Weeds	15 ,,
Cultivation	15 ,,
Freedom from Disease	10 ,,
Evenness of Growth	10 ,,
Total	100

In order that various crops might compete, it was arranged that yields should be based on food value per acre, and crops were compared on the basis of their starch equivalent.

Eight entries were judged, although a number of other entries were received but at a later date withdrawn. Only one entry was received from Zone 2, the remainder being from Zone 1, all competitors in Zone 3 withdrawing from the Competition before judging was carried out.

The following table shows the result of the Competition :—

Competitor.	Yield.	Evenness of Growth.	Freedom from Weeds.	Cultivation.	Freedom from Disease.	Total points.
	50	10	15	15	10	100
ZONE 1.						
S. F. Russell, Serpentine ...	50	8	11½	14	10	93½
L. Pearson, Benger	41½	10	13	13	10	87½
J. A. Hay, Wagerup ...	42	7	15	12	10	86
Fairbridge Farm School, Pinjarra	31	7	13	14	10	75
J. Smith, Wokalup	16	8	8	10	10	52
Do. do.	16	4	6	7	10	43
H. J. Mullins, Waroona ...	22¼	5	...	2	10	39¼
ZONE 2.						
Estate of O. P. Richardson (Only one entry)	7½	9	15	10	10	51½

The summer proved an exceptionally dry one, as is shown by the following rainfall figures for Pinjarra and Brunswick, practically no useful rain having fallen from the end of September, in the case of Pinjarra, and from November, in the case of Brunswick. The excellent yields set out in the table, therefore, were obtained with almost no rain after the crops were sown.

	1930.									1931.		
	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Pinjarra	1·36	2·81	11·65	8·86	5·61	3·77	1·71	1·21	0·56	*Nil*	0·04	0·84
Brunswick ...	1·93	3·45	13·33	8·26	4·75	4·35	2·91	1·58	0·49	*Nil*	0·08	0·68

The winner, Mr. S. F. Russell, was the only competitor in the Competition who irrigated his crops, the crops in this instance consisting of maize (1½ acres), Sudan Grass (1 acre), and lucerne (½-acre).

The second and third competitors relied on maize for their summer fodder crop, exceptionally high yields being obtained when the season is taken into consideration, Mr. L. Pearson's crop averaging 19 tons 7 cwt. 3 qrs. per acre, while that of Mr. J. A. Hay, Wagerup, averaged 19 tons 11 cwt. 2 qrs. per acre. Mr. Pearson's crop was planted on fallow, Mr. Hay's crop following potatoes.

Fairbridge Farm School, Pinjarra, also presented a fine crop of maize which averaged 14 tons per acre.

These results indicate that, provided an area is set aside and fallowed during the winter for the growing of summer crops to be planted the following spring, heavy and reliable yields may be obtained even in a most adverse season.

PROCEDURE FOR THE RAPID ESTIMATION OF SOIL ALKALI AND SALT UNDER FIELD CONDITIONS.

By L. W. Samuel, Soils Officer, and L. J. H. Teakle, Plant Nutrition Officer.

THE PROBLEM—INTRODUCTORY.

With the advance of our knowledge regarding soil conditions and plant growth, there has arisen an increasing demand for information to assist in the evaluation of soils for fertility and to assist in the solution of the soil problems with which farmers are faced. Throughout the civilised world Governments and Associations have established scientific institutions and stations for the study of their particular agricultural problems. With regard to soils, the problems of soil classification, soil acidity, soil alkali and manurial requirements and responses receive particular attention. The results from these institutions and stations have been so incorporated into the art of agriculture that one usually assumes them as a matter of course, forgetting the trials and patient labours of the numerous investigators who contributed their best to the solution of the problems.

The first task of the investigator following the preliminary definition of a problem is the devising of suitable methods for obtaining the information required

to answer the questions involved. Due consideration must be given to soil variability, and conclusions, to be reliable, must be based on a multitude of data, perhaps treated statistically for simplicity of presentation.

The problem facing the authors was a soil classification with particular regard to the presence of alkali and salt. An unfortunate occurrence of deleterious amounts of alkali in some soil types in certain outlying districts of the wheat belt of Western Australia has led to the institution of soil investigations in connection with land settlement. These investigations have involved the recognition of soil types and subtypes, and the examination of numerous samples representing these for alkali and salt content. A sufficient number of samples is taken to enable the results to be treated statistically, and the soil types are mapped and coloured, in accordance with the alkali or salt content.

Examination of the soils in the laboratory of the Government Analyst and Mineralogist has shown the soil alkali to approximate the composition of the salts in sea water (Teakle 1929). In general, in these saline soils about two-thirds of the alkali is common salt (sodium chloride). Little or no sodium carbonate or black alkali exists, but the normal soils all show an accumulation of calcium carbonate, usually in the form of nodules, in the subsoil. Some soil types are calcareous even at the surface.

This group of soil types belongs to the mallee zone of Australia (Prescott 1930).

THE METHODS USED.

The relatively constant composition of the alkali and its freedom from sodium carbonate enables the use of a conductivity method for the determination of total water soluble salts or alkali, with the electrometric method of chloride titration devised and described by Best (1929) as a control.

The conductimetric method adopted for this work is a modification of the American method described in detail by Davis and Bryan (1910). The portable Wheatstone bridge, admirably suited for field work, is used, but the conductivity cup with the soil paste is discarded. Instead a 1:2 or 1:5 soil suspension is used, the conductivity being determined by means of specially designed platinum electrodes coated with platinum black.

The soil samples as brought to the camp from the field in small calico bags are first sieved through a No. 10 wire mesh sieve to remove stones. Portion of each sample is placed in a moisture dish and dried at a temperature between 80°C. and 90°C. for at least four hours in a copper hot-air oven. More complete drying is considered unnecessary as the error due to moisture remaining in the soil after such treatment is very small, probably less than one per cent. of the determination. As moisture dishes, small dishes of first quality tinware two inches in diameter and nine-sixteenths of an inch deep were obtained from a local tinware firm, and numbered permanently by means of steel stamps. A Quirk's patent petrol burner serves to heat the hot air oven and gives a very steady heat, maintaining the oven temperature between 80°C. and 90°C. for hours at a stretch without attention and at low running cost. When five hundred samples were being analysed weekly the consumption of petrol was slightly more than one gallon per week.

From the moisture dishes the soil is weighed by means of a triple beam balance into 2-ounce wide-mouthed bottles. The requisite volume of rain water of very high resistance and negligible salt content is then run on the soil from a pair of semi-automatic burettes (Fig. 1A). The samples are analysed in batches up to 70 in number (the trays used holding just 70 bottles), so that the time taken for the

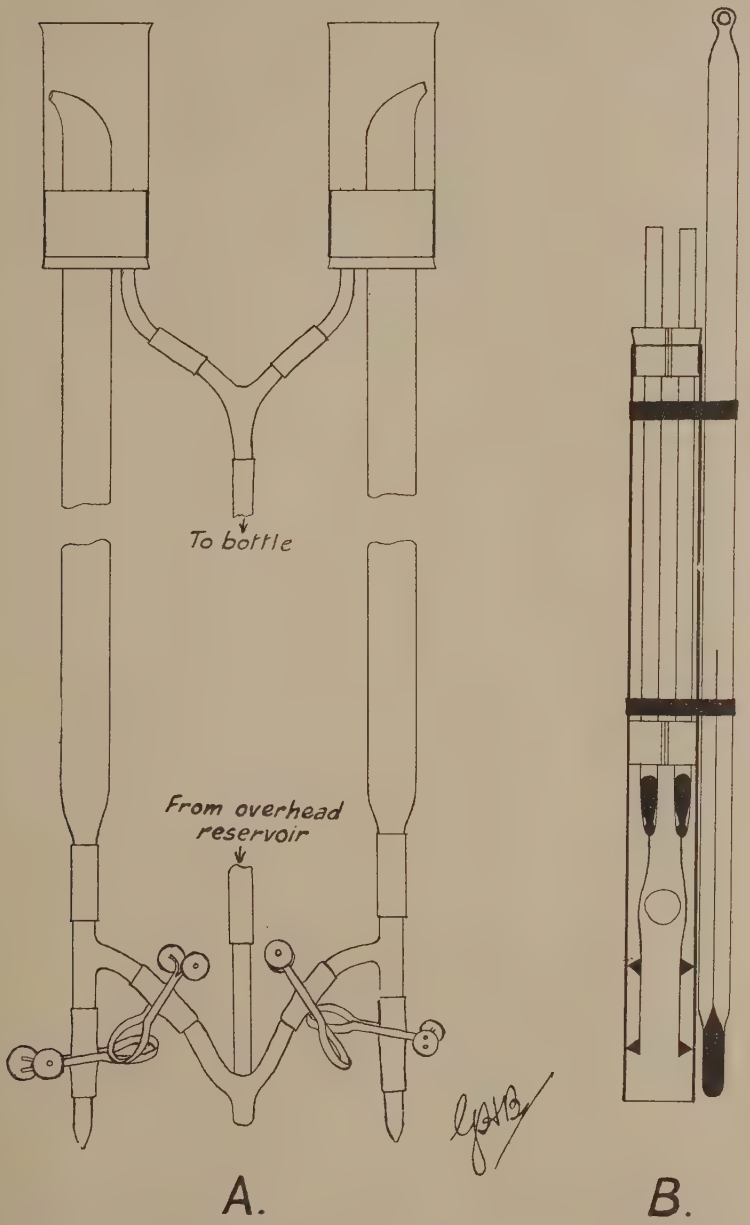


Fig. 1—A.—Diagrammatic representation of the automatic burettes suitable for field work on alkali investigations.

B.—Diagrammatic representation of the platinum electrodes and thermometer unit used in the field work on alkali investigations.

addition of water to them in consecutive order allows ample standing for the extraction of soluble salts. After all have been filled, the bottles are stoppered with numbered corks and well shaken. It is more convenient to number the corks and keep them consecutive than the bottles.

As a result of considerable experience, a 1:5 suspension has been adopted. The advantage of the 1:5 suspension (in our case 10 grams of soil to 50 mls. of water) is that all the soil is saturated merely by running the water on to it. Using a 1:2 suspension, as originally planned, saturation was not attained so readily, particularly in the case of clay soils, so that the full extraction effect during the period of standing before shaking is not obtained. The soil suspension is allowed to stand for 10 or 15 minutes after the first shaking and is then shaken again and its resistance determined by the Wheatstone bridge and the platinum electrodes. The temperature of the suspension is read at the same time to enable the observed resistance to be corrected for temperature. After each sample the electrodes are washed by dipping into rain water and excess water removed by touching the electrode vessel on blotting paper.

The above procedure was found to extract all the soluble salts, for no change of resistance or of chloride content was found even after a further 24 hours' standing.

To ensure the correct adjustment of the instruments the resistance of N/50 potassium chloride solution is determined before and after the reading of each batch of soil suspensions.

Following the determination of the resistance of the soil suspension, a number of samples are selected for titration of chloride ion by Best's method (1929). On the average 20 per cent. of the samples are analysed titrimetrically as well as conductimetrically. Suspension equivalent to 5 grams of dried soil is pipetted from the bottles in which the resistances were read into clean two-ounce bottles with numbered corks. The titration with N/35.5 silver nitrate solution, using a Philip Harris & Co. Ltd. Galvanometer No. 6025, is then made with considerable rapidity as the approximate amount of reagent required to react with the chloride in the soil suspension is known from the resistance value. The samples to be titrated are selected with a view to covering the range obtained in the batch, to checking readings not consistent with the soil type, and to obtaining accurate chloride contents of samples which the resistance values indicate to be on the border line for safe wheat growing.

THE PLATINUM ELECTRODES.

Some special mention must be made of the platinum electrodes (Fig. 1B). These were designed to fit the 2oz. wide-mouthed bottles available. As suitable foil was not available, a piece of platinum wire was rolled to a thickness of about 0.1 mm. and from this two pieces, each 2cms. x 1 cm. in size, were cut. A short piece of fine platinum wire was then welded to the narrow end of each and each wire sealed into a narrow glass lead-in tube. The electrode vessel is a glass tube 6 inches long and ½ inch internal diameter with a hole 7 mm. in diameter 3 cm. from the lower end, to allow free exit of air and entry of solution. Slots in the supporting stoppers are liable to become clogged. Into this glass tube (the electrode vessel) were placed the electrodes, held rigid by passing the lead-in tubes through two two-hole rubber stoppers, the lower one of which fits tightly and completely inside the electrode vessel. Complete rigidity and security of the plates were obtained by bending back for about 1.5 mm. the four corners of each plate and sealing the points into the electrode vessel. The lower edge of each plate is

1 cm. above the bottom end of the glass tube and the top edges of the plates are level with the lower rim of the hole in the electrode vessel. The function of the space between the lower ends of the plates and the vessel itself is to keep the plates in the supernatant liquid and out of the soil at the bottom of the bottle and so avoid as far as possible the mechanical abrasion of the platinum black by the soil particles. In this connection the 1:5 suspension has the further advantage of having a smaller depth of soil in the bottom of the bottle.

The plates are cleaned by boiling first in caustic soda solution and then in diluted sulphuric acid. Following this treatment the electrodes are washed well with distilled water and then coated with platinum black by electrolysis in one per cent. aqueous platinum chloride acidified with hydrochloric acid. Using a 4-volt accumulator as a source of current and reversing the direction of the current every half minute a satisfactory deposit is obtained in half an hour.

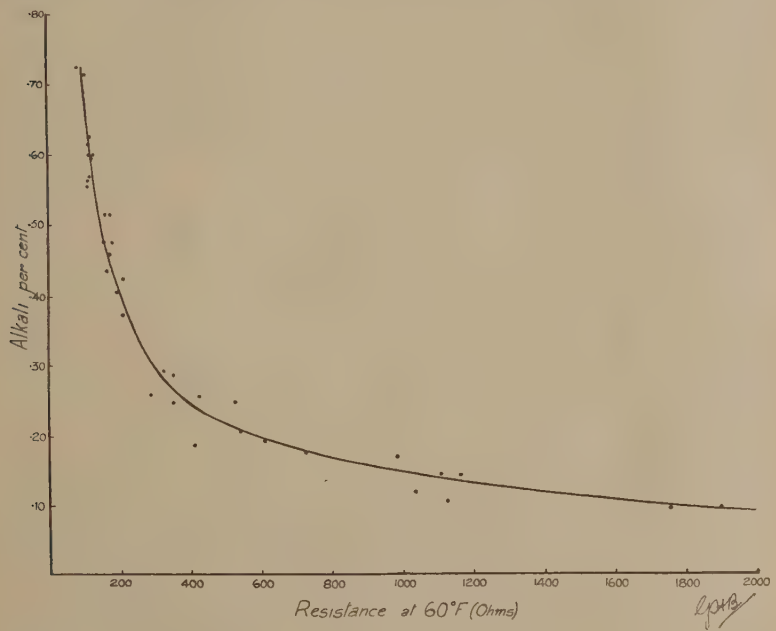


Fig. 2.—Graph for conversion of Resistance of 1 : 5 aqueous suspension of soil at 60°F. to percentage of alkali—showing the scatter of the points obtained.

In use, a thermometer is fixed to the side of the electrode vessel by rubber bands to facilitate the taking of the temperature of the suspension at the same time as the resistance is determined.

The electrodes are connected to the bridge by flexible leads to enable the electrode vessel to be moved from bottle to bottle.

A cell of the dimensions given above gives a reading of the order of 100 ohms at 60°F. for N/50 potassium chloride solution.

THE RESULTS.

The results of the resistance determinations are corrected for temperature and converted into terms of alkali and salt by reference to standardisation graphs prepared for the area under investigation.

The standardisation graph for alkali or total water soluble salts is constructed by plotting the laboratory analyses of type samples for total water soluble salts using the 1:5 water extract against the resistances as determined by the Wheatstone bridge. A typical graph is illustrated in Fig. 2. As a rule the points on the water soluble salts : resistance graph scatter fairly widely about the mean curve, especially on the lower range of the curve. This is apparently due to the variations in the composition of soil alkali and to the fact that the proportion of com-

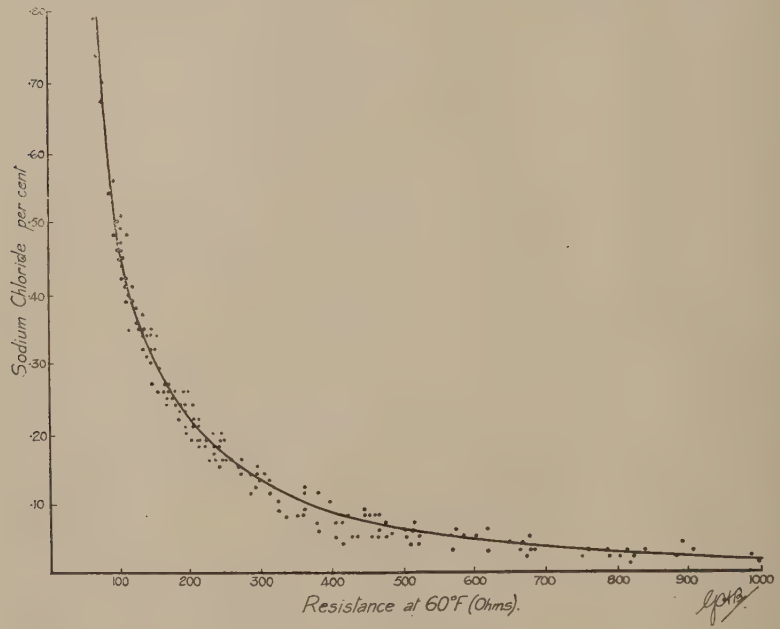


Fig. 3.—Graph for conversion of resistance of 1 : 5 aqueous suspension of soil at 60°F. to percentage of sodium chloride (salt)—showing the scatter of the points obtained.

mon salt to alkali decreases as the quantity of alkali in the soil is lowered. As the ionisation constants of the various salts and the transport numbers of the different ions vary greatly it is to be expected that variations in the composition of the alkali will affect the results.

The standardisation graph for salt is constructed from the resistance and the sodium chloride content (obtained from the chloride content) obtained by actual field demonstrations; such a graph is illustrated in Fig. 3. The points scatter much less widely than on the alkali graph, but the graph has to be revised for different districts, even in the same area. Fig. 4 illustrates the divergence of

the sodium chloride : resistance graphs which is obtained for adjacent districts in the same area; in this case Lake Newton (southern), and Lake Fox (northern). It is to be noted that the greatest discrepancy occurs in the soils of low sodium chloride content, the differences in the curves for more saline soils being more or less insignificant.

When the nature of the subject is considered and all the factors leading to soil heterogeneity are recognised, it is surprising that such remarkably good agreement is obtained no matter what the physical texture of the soil may be. It is rare to obtain values of sodium chloride by the resistance and titration methods which differ by more than 0.03 per cent. sodium chloride using the same sample.

In practice all results are expressed in terms of sodium chloride (calculated from the chloride content) as the sodium chloride graphs for different districts are obtained in the field. From the analyses of type samples for alkali or water

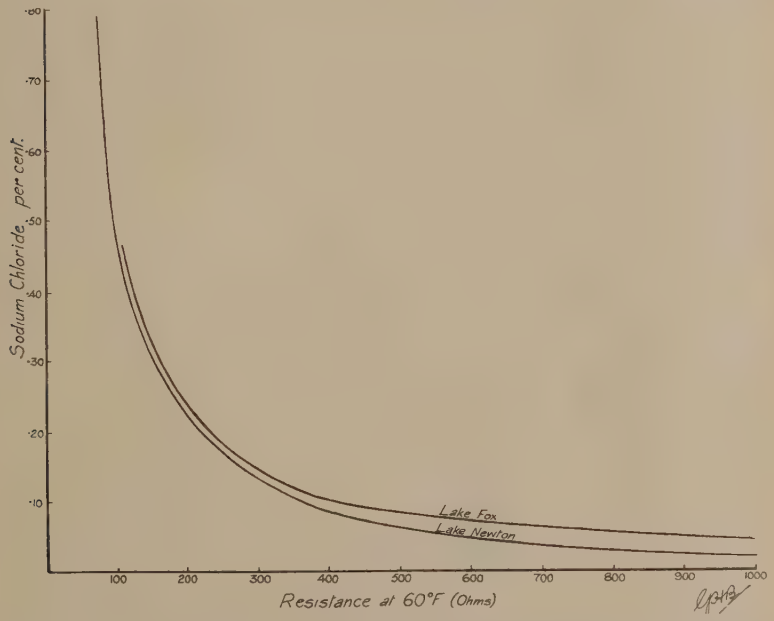


Fig. 4.—Graphs obtained for conversion of resistance of the soil suspension to percentage of sodium chloride (salt) in soils from two different districts in one area.

soluble salts, using a 1:5 water extract, a conversion graph has been constructed so that the results may be expressed both in terms of alkali and sodium chloride. The conversion graph (Fig. 5) illustrates there is a fairly direct and definite relation between alkali and sodium chloride in soils containing above 0.18 per cent. alkali. In the normal soils, those containing insignificant quantities of alkali, sodium chloride becomes an unimportant constituent of the soluble matter.

It is essential for a soil alkali survey that soil sampling be very thorough, so that the results may be treated statistically. This necessitates the accurate examination of large numbers of samples and the ordinary laboratory methods are

totally inadequate. The method must be very rapid and suitable for field practice; rapid enough to allow the examination of between 200 and 250 samples per day by a chemist and an asistant. The procedure described fulfils these requirements, and the necessary equipment is readily arranged in a 10ft. x 12ft. tent with conveniences made of boxes and a table top. The degree of accuracy is high, very much higher than that of sampling under ordinary field conditions. No tedious filtrations are needed and the difficulties of removing suspended matter are eliminated as the Wheatstone bridge is affected only by electrolytes. In fact, the resistance may be taken as the physiological index of the soil with respect to alkali. The maximum error to be expected is approximately 0.03 per cent. sodium chloride. For alkali the error is somewhat higher but, physiologically, is of the same order of magnitude.

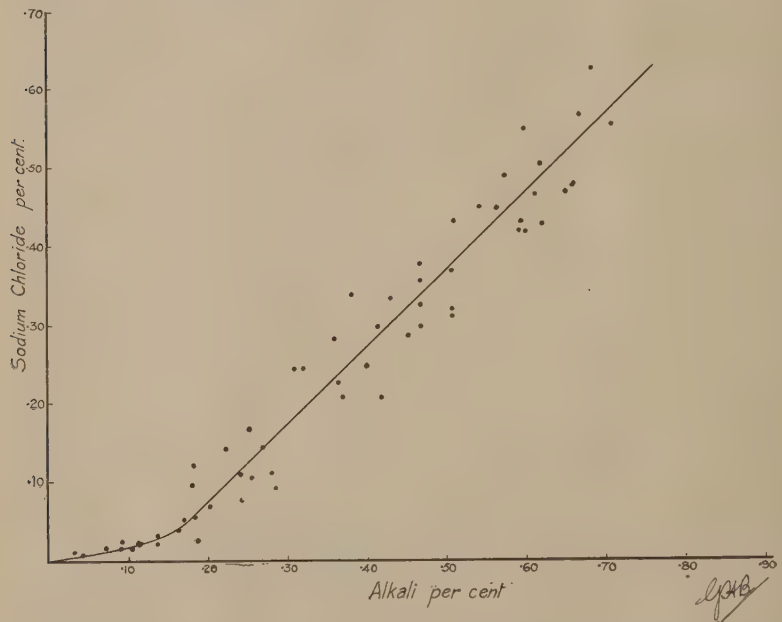


Fig. 5.—Graph for conversion of percentage of sodium chloride to percentage of alkali in soils using the conductivity method described. The dots show the scattering of the points through which the conversion curve is drawn and reflect the variations to be expected in individual samples.

SUMMARY.

A convenient procedure for the rapid examination of soils in the field for alkali and salt content is described.

The resistance of the 1:2 or 1:5 soil-water suspension is determined between platinum electrodes using a portable Wheatstone bridge and this converted to alkali and salt contents by means of standardisation graphs.

The results of the resistance determinations are checked by the titration of chloride in 20 per cent. of the samples, using Best's electrometric method.

Between 200 and 250 samples may be examined and checked per day by a chemist and an assistant using this procedure.

The authors wish to acknowledge the assistance of Mr. G. H. Burvill in the preparation of the manuscript, and particularly for the preparation of the figures for publication.

BIBLIOGRAPHY.

Best, R. J.:

1929. A Rapid Electrometric Method for Determining the Chloride Content of Soils. Jour. Agr. Sci. 19; 533-540, 1929.

Davis, R. O. E. and Bryan, H.:

1910. The Electrical Bridge for the Determination of Soluble Salts in Soils, U.S.D.A., Bur. Soils, Bul. 61.

Prescott, J. A.:

1930. A Tentative Soil Map of Australia. Jour. C.S.I.R. (Aust.) 3: 123-124.

Teakle, L. J. H.:

1929. Soil Alkali. Jour. Agric. (West Aus.), 2nd series, 6: 88-102.

THE GERMINATION OF CRIMSON CLOVER SEED.

(*Trifolium incarnatum.*)

A. B. Adams, B.Sc.Agr.

Capt. R. H. Bell, of Balingup, reports that Crimson Clover does well as pasture on his farm the first year of sowing. Although the plants seed prolifically, there is practically no growth the second season from the self-sown seed; if, however, the seed is harvested and sown with the first rains, it gives good germination and a better pasture than is usually obtained from the first year of Subterranean Clover.

On carrying out germination tests with some of the saved seed, from 95 to 100 per cent. germinated within 48 hours. The few that did not germinate within that time germinated later. There were no hard-shelled seeds.

It is evident from this result that the reason that there is little or no growth from the self-sown seed is because the seed germinates so readily that a light shower, or possibly a heavy dew, will cause it to commence growth, only to die with succeeding hot, dry weather.

Crimson Clover probably had the habit of forming hard-shelled seeds when in the wild condition, but has been grown as a farm crop for such a long period that it forms these hard seeds only very exceptionally, if at all, as the usual practice of growing such crops for seed will encourage that type of plant that bears seeds that will germinate immediately they are sown, and discourages those plants that originate from hard-shelled seeds.

This absence of hard-shelled seeds is probably the real reason that Crimson Clover, a plant well suited to our soils and climate, is so little grown.

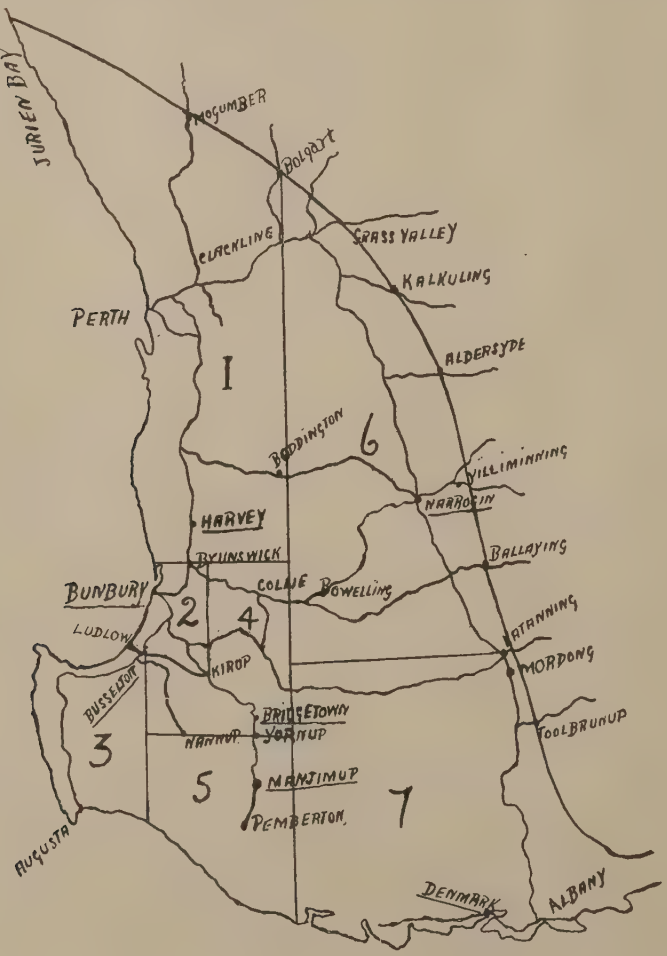
BETTER DAIRYING COMPETITION.

With the object of encouraging increased butter production and improved methods of dairy farming, the Australian Dairy Council has made available a sum of money which is being utilised to conduct a "*Better Dairying Competition.*"

For this purpose the Dairy Belt (*i.e.*, land west of the 20-inch rainfall line) has been divided into seven zones, with prizes as follows :—

First Prize in each Zone	....	....	....	£8 8s.
Second Prize in each Zone	....	....	....	£5 5s.
Third Prize in each Zone	....	....	....	£2 2s.

In addition a Champion Prize of £10 10s. has been awarded by Messrs. Cuming, Smith and Mt. Lyell Fertiliser Co., to be competed for by the First Prize winners in each zone.



Judging will be carried out by Officers of the Dairy Branch, Department of Agriculture.

Zone boundaries are shown on map, with the Agricultural Societies in charge underlined, as follows :—

Zone 1.—Agricultural Society, Harvey.
Zone 2.—Wellington Agricultural Society, Bunbury.
Zone 3.—Agricultural Society, Busselton.
Zone 4.—Agricultural Society, Bridgetown.
Zone 5.—Agricultural Society, Manjimup.
Zone 6.—Agricultural Society, Narrogin.
Zone 7.—Agricultural Society, Denmark.

Entries should be made through the Agricultural Society in charge of each zone.

NO ENTRY FEE TO BE CHARGED.

ENTRIES CLOSE AUGUST 31st, 1931.

Judging will be carried out from November 1st, 1931, to January 31st, 1932. Entries to be judged on the following points :—

75 points	....	Farm Management.
100 ,,	....	Dairy Herd.
100 ,,	....	Pasture and Fodder Crops.
150 ,,	....	Fodder Conservation, particularly Silage.
25 ,,	....	Utilisation of Separated Milk for Poultry, Pigs, etc.
50 ,,	....	Butter Fat Production per acre.

All inquiries should be addressed to the Secretary of the Agricultural Society in charge of Zone.

CARNIOLAN BEES.

H. Willoughby Lance, Government Apiculturist.

A contributor, writing in "The Bee World" about different races of bees says—"Recently it has been found that another race possesses all the good qualities of both black and yellow, besides showing other very desirable features. 'Grey Carniolans' are as quiet upon the combs and even gentler than Italians. They are as hardy and as good workers as any blacks can be, but combs built by greys are snow white and clean, and in their hives there is always very little profolis, so that combs are readily removable.

"Of still greater importance for the beginner as well as for the professional is the fact that, by proper management, they can easily be induced to rear brood both in and out of season, so the very smallest nucleus will rapidly build up to a powerful colony. Therefore, grey Carniolans are the only bees for the commercial migratory beekeeper, wanting to obtain large honey crops in spring, summer and autumn."

All that this correspondent says is confirmed by our experience in Western Australia. The verdict of those that have given them a trial is that they are the race best suited to our State. One large firm of commercial beekeepers that has tried all the available races of bees commenced with Carniolans about six years ago

and for two or three years carefully compared them with the other races, with the result that 80 per cent. of their bees are now Carniolan, or have the Carniolan strain on either the Queen or Drone's side.

Carni-Italian (Carni Queen and Italian Drone) or Italian-Carni (Italian Queen and Carniolan Drone) are found to be equal to Carniolan pure in most cases, but after the second or third generation they usually lose some of their most desirable characteristics. It is advisable, therefore, to introduce fresh pure stock at least every two years.

It is with the object of being able to supply pure stock that the Government have established a Carniolan Apiary at Rottnest Island. The Island is 12 miles from the mainland and as there are no other bees on the Island, there can be no

One of Hochegger's movable house-apiaries on wheels, containing from 40 to 50 strong Carniolan colonies.

"The Bee World."

doubt about the purity of the race being maintained. It is intended to import fresh breeding Queens each season direct from Carniolia, so that the stamina of the race may be maintained. Briefly summarised, the advantages of the "Grey" Carniolans are :—

(1.) They are longer lived than Italians or Blacks, and as a consquence there is less brood in the hives for the same strength of colony.

(2.) They produce more honey than the average Italian or Black, no doubt partly due to the fact that they require less brood to keep up the strength of the hives, and, therefore, consume less food in brood rearing. They also appear to have stronger wings than the other races, which would doubtless account for their longer life and better honey storing capacity, as they can work in wet and windy weather when Italians would stay at home. We recently sent a colony of Carni-Italians to the South-West and the purchaser was exceedingly pleased to find that they were working the Karri blossom all through the rain. As the Karri blossoms in the winter, this trait is a most important one for the honey producer of the South-West.

(3.) They are very quiet to handle. During the honey season, one never need wear a veil, and very little smoke, if any, is required. Of course, when there is a dearth of honey or hives have been badly disturbed, the quietest colonies become somewhat pugnacious. I have opened hives under urgent circumstances half an hour before sunset and have almost been driven away from Italian colonies, but have had no difficulty with Carniolans.

In past years there has been a prejudice against Carniolans, as they were reported to be great swarmers. This has not been borne out by recent experience in Australia. The prejudice was probably due to the fact that in the early days the importance of plenty of room in advance was not realised by beekeepers. It is generally recognised in these days that to obtain a good honey crop and to reduce swarming, the bees must have plenty of room in advance. The Carniolans, being rapid honey gatherers, probably caught many beekeepers napping, with the result "swarming." Mr. W. S. Pender, writing recently in the "Australian Bee Keeper" says that he has been trying Carniolans for two seasons, and that he "gave these Carniolans every inducement to swarm, the hives being left over-full of honey, and had not had one swarm from them in his apiary of 30 colonies. The only two swarms he had were pure Italian."

Rottnest Apiary, 1931.

Now I would not advise beekeepers to "give them every inducement to swarm," to test them as Mr. Pender did. I would say "give them plenty of room to store," so that you may obtain the full advantage of the honey crop.

In comparing the various races of bees, it should be remembered that the natural conditions of the native country of the race must have a great influence upon their physical structure and characteristics. If the race comes from a country where all is sunny and calm, and where there is plenty of nectar to be gathered without battling with severe weather conditions, one would not expect to find the race so hardy as those from a mountainous region where the conditions are hard,

the honey harvests small and gained under very great difficulties and over great distances, and where, in the past centuries, beekeepers did not help artificially to improve the conditions. In such countries, the law of the survival of the fittest operated, and a strong virile race of bees results, and this appears to be what has happened in Carniolia. Why this selfsame race should at the same time be so quiet to handle is not so easily explained. It may be that, in their homeland, they have not so many enemies to fight against as in some other countries, and, therefore, are more trustful when carefully handled.

A paragraph in "The Bee World" gives an interesting fact :—"That the Austrian Empress Maria Theresia (1740-1780) appointed in 1770, the famous beekeeper of that time, Anton Jansa (pronounced Jansha) from Upper Carniolia to come to the Court as an instructor for beekeeping for Vienna and Lower Austria. Jansa was there only three years, for he passed away in 1773 ; but in this short time he increased the productiveness of beekeeping amazingly by introducing Carniolan

Rottnest Apiary, 1931.

bees, and hives for migratory beekeeping, as the originator of which he is respected in Austria." The scientific name of these bees is "Apis mellifica Norica," signifying that these bees are found all over the districts of the old Roman province of Noricum and not only in Carniolia, although at the present time the principal breeders are situated in Carniolia, which has given them that name. Those bred in Carniolia, however, appear to be more distinct, as some of the Noric bees tend towards the leather Italians.

The prices of Carniolan queens are as follow :—

	s.	d.
Carniolans, guaranteed pure selected	21	0
Carni-Italian, Italian-Carni	12	6
Untested	7	6

The illustrations show two views of Rottnest Apiary and Bee-house, and one of a movable house apiary of Mr. Hochegger, of Styria, containing 40 to 50 colonies of Carniolans.

OAT VARIETY TRIALS—SOUTH-WEST.

G. K. Baron-Hay, Superintendent of Dairying.

The value of cereal crops has been specially stressed during the last two years to dairy farmers, the hay obtained from these crops being reserved and fed to dairy cattle during the flush period of the year when the feed available as pasture is composed almost entirely of leguminous plants, principally Subterranean Clover.

Jardee.—On the property of Mr. J. W. Pritchard. Conducted by Agricultural Adviser M. Cullity.

Rate of Seeding: 2 bushels per acre.

Fertiliser: Superphosphate 2 cwts. per acre.

Land composed of friable loam having been under Clover for five years.

Yields are shown in the following table:—

Variety.	Planted.	Yield (average of 3 plots.)				Percentage Yield.
		tons	cwts.	qrs.	lbs.	
Guyra	May 9th ...	2	2	3	6	129
Lachlan...	do. ...	1	17	3	17	114
Burt's Early	do. ...	1	14	1	6	103
Algerian	do. ...	1	13	0	22	100
Mulga	do. ...	1	11	0	0	93

"Burt's Early" and "Mulga" were noted to grow rapidly in the early stages and were valuable as a source of early green feed.

Denmark.—On the property of Mr. E. Russell, Group 42. Conducted by Agricultural Adviser G. Gauntlett.

Owing to heavy rains soon after these plots were sown, a considerable amount of "washing" was experienced, germination being poor.

Yields are as follow:—

Variety.	Yield (Green) (average of 3 plots).				Percentage Yield.
	tons.	cwts.	qrs.	lbs.	
Algerian	2	14	2	27	100
Guyra	2	11	3	12	95
Lachlan	2	7	2	4	87
Mulga	2	7	2	4	87
Burt's Early	2	6	0	11	84

Marradong.—On the property of Mrs. L. Pollard. Conducted by Dairy Adviser C. Giles.

Land composed of good friable loam.

Seed sown at the rate of 60 lbs. per acre.

Superphosphate 1 cwt. per acre.

"Burt's Early" gave growth most suitable for early feed.

Yields are as follow :—

Variety.	Yield (Green) (average of 3 plots).				Percentage Yield.
	tons.	cwts.	qts.	lbs.	
Algerian	2	4	0	23	100
Lachlan	2	0	2	12	92
Burt's Early	1	18	0	0	86
Mulga	1	17	3	13	86
Guyra	2	1	0	22	93

The average percentage yields of the varieties of Oats used at the three centres named above indicate that for general planting a good strain of = "Algerian" compares favourably with other known varieties for hay purposes, "Burt's Early" or "Mulga" being specially valuable for the production of early feed.

The percentage yields are as follow :—

Algerian	100
Burt's Early	88
Lachlan	95
Guyra	98½
Mulga	99

PEDIGREE SEED.

G. L. THROSSELL, Dipl. Agric., Agricultural Adviser.

The tremendous strides which have taken place in the development in wheat farming in Australia during this century are due to the improvement in cultural methods, which include the use of superphosphate, together with the breeding of cereals suited to the conditions under which they are grown. In the main the farming community has been quick in availing itself of anything new in regard to farming methods, but a factor which they do not seem to appreciate as much as they should, is the value of good quality seed. Stock breeders have long realised the importance of using pure bred sires and dams of high productivity and quality, combined with vigorous culling and selection for the improvement and maintenance of their flocks and herds. In this way the average production of milk and butter of dairy herds and of wool from the sheep flocks have been increased enormously.

In crop production systematic plant breeding and selection has raised the sugar content of the sugar beet from 6 to 7 per cent. of sugar to 20-25 per cent.

Similarly in wheat production the cereal breeders have evolved wheats of high yielding capacity, combined with drought and disease resistance, with grain of high flour strength. Whereas in the last century it was necessary to import wheats from Canada in order to blend the local wheats to produce a flour suitable for making bread, to-day the quality of Australain flour is unexcelled. The diseases which attack the growing wheat crop are gradually being overcome by the breeding of resistant varieties combined with the use of chemical fungicides. In this way the ravages of rust and smuts are being minimised.

The wheat farmer has an advantage over the stock breeder inasmuch that the successful stockbreeder must be a specialist in the art of culling and selecting in

order to maintain and improve his flock. The wheat farmer, on the other hand, does not require this specialised training. What he does require is a true appreciation of the value of seed of the best quality.

The requirements of a variety of wheat are that it—

(1) is prolific, *i.e.*, of high yielding capacity;
(2) is true to name and type, *i.e.*, free from admixture and foreign grains;
(3) is suitable for the purpose for which it is grown;
(4) will resist diseases;
(5) will produce grain of good quality; and
(6) that it does not have undesirable characteristics, such as weakness of straw, shedding, etc.

How can these qualities of excellence be maintained? If a farmer grades his wheat thoroughly he should eliminate all foreign matter, cracked, shrivelled and inferior grains, and obtain a plump uniform sample. This gives a uniform rate of seeding and produces a healthy vigorous wheat plant. An experiment conducted at the Wuyna Experiment Farm in Victoria in 1911 showed that the first quality graded wheat yielded 2 bus. 39 lbs. per acre more than the same wheat ungraded (harvester sample). Quite apart from the increased yield obtained, grading pays for itself on account of the screenings saved and available for stock feed, which otherwise would have been wasted.

However, grading alone cannot maintain the purity of the sample, nor evolve a better strain from the point of view of productivity, disease resistance, and other desirable characteristics. Modern farming machinery renders it almost impossible for even the most careful farmer to keep his varieties pure, with the result that in time the percentage of admixture increases and the value of that variety as a yielder and a disease resister is reduced.

Because of this the Department of Agriculture, in the interests of the farmer, carries out the intricate and specialised work of seed selection for the farmer. The work may be divided into three sections.

(a) Selection to maintain the type and improve the varieties already in existence.
(b) Cross breeding to produce better varieties; and
(c) Disease resistance tests to improve the disease resistance of these varieties.

The varieties already in cultivation are submitted to tests for yielding qualities and disease resistance—and in this way prolific and disease resistant strains are evolved. The less prolific and resistant strains are rejected. Having evolved the best strains, sufficient seed is then raised for distribution to farmers. It must be remembered that this work is carried out each year, and the selection of improved strains is always going on.

These improved strains are made available to the farmer as pedigree graded seed, and as may be expected, cost a little more than ordinary seed wheat, but in proportion to its value to the wheat farmer the cost is indeed a small one. It is surprising to find farmers who do not mind paying large sums for stud rams, bulls, and other stud stock, and yet who will not pay a little extra for stud seed. Of course, to plant the whole area cropped with pedigree seed would certainly be an expensive proposition. The plan advocated is for a farmer to obtain each year a small lot, say, five to 10 bags of pedigree seed, depending on the total area cropped, of each of the varieties he grows. Then by planting this seed on carefully prepared clean fallow, free of self-sown wheat, and by keeping the seed drill and

harvesting machinery as clean as possible, he can raise his own seed with which to sow his bulk crop the following year.

Many farmers who realise the advantage of this practice follow this policy, and it pays them to do so. Good seed is a cog in the machinery of better crop production—if this cog is missing or broken the machinery cannot function properly.

PEDIGREE SEED WHEAT AND OATS.

I. THOMAS,
Superintendent of Wheat Farms.

It has long been recognised amongst stock breeders how potent, for increasing the quality of their flocks and herds, is the use of stud animals selected specially for their productivity. Similarly, the value of the pedigree seeds of selected strains of plants chosen also for their high productivity and disease resistance, is now realised by up-to-date farmers.

One of the principal functions of the State Experiment Farms has been the production of selected pedigree seed of standard varieties of wheat and oats. In view of the special work and facilities required for the production and maintenance of the purity of this seed its cost is relatively high.

With a view to assisting the farmers in this present time of stress, and recognising that, owing to the abnormally low price of wheat ruling, some farmers may not be in a position to purchase selected pedigree seed, and will thus be prevented from taking advantage of the benefits to be derived from its use if the usual prices obtain, the Minister for Agriculture (Hon. P. D. Ferguson) has decided to make drastic reductions in them. This policy has been further influenced by an appreciation of the fact that the use of this seed is an important factor in promoting a greater yield per acre, and thereby reducing the costs of production.

With the exception of the new varieties "Bencubbin" and "Sutton," the prices are as under:—

Wheat—

For 10-bag lots and over—12s. per bag of 3 bushels.
Lots under 10 bags—14s. per bag of 3 bushels.

Oats—

For 10-bag lots and over—8s. per bag of 3 bushels.
Lots under 10 bags—10s. per bag of 3 bushels.

These will include rail freight to the siding nearest to the farmer's holding in the Wheat Belts.

The following varieties are at present available:—

Wheat.—Gluyas Early, Merredin, Nabawa, Noongaar, S.H.J., Yandilla King.

Oats.—Mulga.

In addition to the above varieties there is a small quantity of the new variety of wheat "Bencubbin" available. The price of this variety is £1 per bag, freight paid, as in the case of the other varieties. As the quantity of seed of "Bencubbin" is limited, and owing to the large number of applications already to hand, it has been found necessary to limit the amount to be supplied to any one applicant to one bag.

Any farmers desirous of obtaining pedigree seed wheat and oats of the above varieties should forward their application direct to the Department of Agriculture at an early date.

DESCRIPTION OF STANDARD VARIETIES.

WHEAT.

Yandilla King.—A late variety with stiff and upstanding straw; a profuse stooler and good yielder. It is the best variety of the late class, and because of its excellent record on varied conditions of soil and climate, it is considered the standard late variety. It is resistant to Flag Smut and Rust escaping, but susceptible to Bunt.

Sutton.—This is a new wheat produced by the Department of Agriculture, and is a cross between Nabawa and Carrabin. It is a late variety, maturing about the same time as Yandilla King, and is suitable both for hay and grain. It is fairly resistant to Bunt, resistant to Flag Smut, and no Summer Rust has been noticed on the straw.

Nabawa.—This variety has been produced by the Western Australian Department of Agriculture with the object of replacing "Federation" in those districts where the liability to Rust attacks renders the latter an undesirable variety. It has to its credit performances of great merit in both heavy and light land, and it has been found a prolific yielder in every district of the Wheat Belt; it is, therefore, the standard variety of the mid-season class. It is susceptible to Bunt, but resistant to Flag Smut.

Bencubbin.—A recent production of the Department of Agriculture is a cross between Nabawa and Gluyas Early, and promises to be an improvement on both parents for yield. It is of the same maturity as Nabawa, and is slightly taller in growth. It is equally resistant to Flag Smut, but is susceptible to Bunt.

Gluyas Early.—The standard variety of the "early" class. It has a great capacity for consistently yielding well under a low rainfall, but has a tendency to lodge, especially in heavy weather. It is very susceptible to Bunt and Flag Smut, but is resistant to Rust.

Noongaar.—This is also a recent production of the Department of Agriculture, and is probably the earliest variety in general cultivation in this State. In the trials at Kalgoorlie it has proved extremely drought resistant, and is now under trial in the extreme Eastern Belt, for which it is considered to be suitable for planting in the latter part of May. It is susceptible to Bunt, but resistant to Flag Smut.

OATS.

Algerian.—This standard late maturing variety is more suitable for grain than hay, producing an excellent quality grain. Though a slower grower in its early stages, it makes rapid growth with the approach of warmer weather. It is not suitable for districts with low rainfall.

Guyra.—This is the standard mid-season variety in this State. It is a general purpose variety, being suitable for grazing, hay, grain and silage. It is, however, mostly favoured for grain production.

Mulga.—This variety is suitable for hay, grain and silage, maturing about the same time as Burt's Early, which variety it rivals in providing green feed for sheep. It yields well, produces grain of good quality, and is particularly suited for districts of low rainfall.

Burt's Early.—An early variety of oats, a quick and tall grower, which provides palatable and succulent green feed, as well as an excellent and heavy cut of hay. It is principally a hay variety, much valued by those who combine much stock carrying with their wheat growing.

FIELD EXPERIMENTS WITH WHEAT, 1930.

MERREDIN EXPERIMENT FARM.

I. THOMAS, Superintendent of Wheat Farms,
and
J. H. LANGFIELD, Farm Manager.

In addition to the experiments published in the March issue of the *Journal*, the following experiments were conducted at the Merredin Experiment Farm during 1930:—

Fallow and Non-Fallow.
Time of Ploughing.
Mulching.
Nitrogen.

The total rainfall for the year ending 31/12/30 was 13.33 inches, and during the growing period 8.23 inches. The following table shows the monthly rainfall together with the average over a period of 19 years:—

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1930	...	1	281	186	40	363	137	184	65	34	823	1	41	1,333
Average, 19 years ...	55	56	125	79	130	195	188	140	93	75	821	44	54	1,234

The season opened with splendid rains during March and April, 4.67 inches being recorded; this was responsible for giving the weeds a good start before seeding commenced. May was a dry month, and lent itself admirably for killing the weeds; it was also responsible for allowing the seeding to proceed uninterrupted. Owing to the growth of weeds on the fallow it was necessary to cultivate several times in order to kill them. This was responsible for the loss of moisture in the surface soil, and delayed the germination of the May plantings until after rain, which fell on June 1st.

The season progressed very satisfactorily until September, when the rainfall was again very light, only 65 points being registered in that month in eight falls, the heaviest of which was 16 points. October was also dry (34 points only being recorded).

The land on which the experiments were planted originally carried a forest of salmon gum and gimlet, and the soil is typical of that class of country. The farm is worked on a three year rotation, namely fallow, crops (mainly wheat and oats) and pasture.

The experimental block received uniform treatment, being ploughed with a springtyne cultivated in March, after rain. Excepting where otherwise stated, or heavy disc plough to a depth of 4in. in June, 1929, reploughed in August and where the requirements of an experiment necessitated a modification of the treatment, the fallow was given a further cultivation with a springtyne cultivator prior to seeding.

Fallow v. Non-Fallow Experiment, 1930.

The object of this experiment, which has been conducted since 1925, is to demonstrate the advantages of fallowing for the wheat crop.

Two plots, each one quarter of an acre in area, were set apart for the experiment, one of which was left unfallowed, and the other was ploughed 4 inches deep in July, 1929, with a disc plough, and springtyne cultivated in spring. The unfallowed plot was ploughed after rain on 11th March, 1930, the condition of the land being such that excellent work was done.

Both plots were springtyne cultivated in April and disc cultivated before seeding when they were in splendid condition. They were harrowed after being planted on May 23rd.

The results obtained are as follows:—

FALLOW AND NON-FALLOW EXPERIMENT, 1930.

Variety—Gluyas Early. Planted on 23rd May, 1930. Superphosphate—150lbs. per acre.
Seed—45lbs. per acre.

Treatment.	Computed Yields per acre, 1930.		Percentage Yields, 1930.	Average Yields per acre, 1925-30.		Percentage Yields, 1925-30.
	bus.	lbs.	%	bus.	lbs.	%
Fallow	27	40	100	21	5	100
Non-Fallow	28	44	104	15	14	72

This is the first occasion since the inception of the experiment that the yields obtained from the unfallowed plots have been higher than those from the fallowed plots. From the average results for the past six years it will be seen that the fallowed plots have exceeded the unfallowed plots by nearly six bushels. It must also be remembered that the advantage of fallowing is most evident when the season is least favourable. The past season was a most favourable one, and the early March rains were particularly helpful in assisting in the preparation of a good seed-bed on the unfallowed plot. In addition, the heavy winter rains furnished an adequate moisture supply. The percentage results since 1925 illustrate the advantage of fallow in adverse years:—

Year.	Fallowed.	Unfallowed.
	%	%
1925	100 ..	38
1926	100 ..	58
1927	100 ..	87
1928	100 ..	44
1929	100 ..	72
1930	100 ..	104
Average	100 ..	72

Time of Ploughing Experiment, 1930.

A Time of Ploughing Experiment has been conducted at this farm for the past seven years, with the object of determining the effect of early and late winter fallowing on the resultant crops grown on heavy land. In the previous six years (1924-29) the experiment consisted of two plots, each half an acre in area, one representing early winter fallow, being ploughed during the first week in June, and the other, late winter fallow, ploughed the last week in August. The average results over this period are distinctly in favour of the early winter fallow.

TIME OF PLOUGHING EXPERIMENT.

AVERAGE RESULTS, 1924–1929—(6 YEARS).

Time of Ploughing.	Average Yield per acre, 1924–29.	Average Percentage Yield per acre, 1924–29.
	bus. lbs.	%
First week in June	18 46	100
Last week in August	14 55	80

This year the experiment was slightly modified, a third plot being included, the times of ploughing being respectively mid-June, mid-July and mid-August, and the area of the plots each one quarter of an acre. All plots were ploughed to a uniform depth of 4 inches with a disc plough, the land being in good order when the June and July plots were ploughed, but was becoming hard when the August plots were ploughed, and hence turned up cloddy.

All the plots received the same subsequent treatment, being springtyne cultivated in spring, March and April, and were disc cultivated in May prior to seeding on 23rd May and harrowed after.

During the growing period it was noticed that the June ploughed plot was practically free from Takeall, whilst there was a little of this disease showing in the July plot and several patches in the August plot. This fact has been observed in previous years.

The results obtained are as follow:—

TIME OF PLOUGHING EXPERIMENT.

Variety—Gluyas Early. Seed—45lbs. per acre. Planted—23rd May, 1930.
Superphosphate—150lbs. per acre.

Time of Ploughing.	Computed Yield per acre, 1930.	Percentage Yield per acre, 1930.
	bus. lbs.	%
Mid July	22 48	81
Mid June	28 0	100
Mid August	20 16	72

The results are in conformity with the average results from the previous six years and emphasise the advantage of early ploughing.

Mulching Experiment, 1930.

The object of this experiment, which has been conducted for the past 15 years, is to determine the extent and under what conditions the cultivation of winter fallowed land is profitable during the spring and summer.

Three plots were necessary, and to meet the requirements of the experiment they were treated as follows:—

Plot 1.—Cultivated during spring, again when required during summer after 25 points of rain or over, and again prior to seeding, the object being to maintain a mulch throughout the fallowed period and to destroy weed growth.

Plot 2.—Cultivated during spring and prior to seeding only (ordinary fallow).

Plot 3.—Cultivated prior to seeding only (neglected fallow).

The land upon which the experiment was conducted was typical salmon gum and gimlet timber country and was ploughed with a disc plough to a depth of 4 inches in June, 1929. Plots 1 and 2 were reploughed in August and Plot 1 received further cultivations after summer rains; all plots were springtyne cultivated in March and prior to seeding on 26th April.

A good germination was obtained, but owing to the dry conditions prevailing during May the plots made very slow growth during the early stages.

The results are shown in the following table:—

MULCHING EXPERIMENT.

Planted on 26th April. Variety—Nabawa. Superphosphate—150lbs. per acre.
Seed—45lbs. per acre.

Cultivations.	Computed Yield per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1915–30.	Percentage Yields, 1915–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus lbs.	bus. lbs.	%	bus. lbs.	%
Mulched in spring, after rain during summer and before planting	35 20	34 8	34 16	33 44	34 48	34 27	100	21 42	102
Mulched in spring and before planting only	33 36	34 56	35 4	34 16	34 32	34 29	100	21 19	100
Mulched before planting only	33 52	34 24	34 48	33 36	33 28	34 2	99	20 14	95

There was very little difference in the yields of the plots this year. The average results for the whole period during which the experiment has been conducted, however, indicate that the general practice should be to cultivate the fallow during spring and again prior to seeding, and where the ground is weedy this cultivation should be supplemented by additional cultivations after rain during the summer months.

Nitrogen Experiment, 1930.

The objects of this experiment are:—

1. To determine whether increased yields are obtained when heavy dressings of sulphate of ammonia are applied to the wheat crop in addition to an application of superphosphate.
2. To ascertain whether it is advantageous to apply only part of this nitrogenous fertiliser at seeding time and part during the month of August.

For the purposes of the experiment two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwts. respectively.

Superphosphate was applied to all plots at the rate of 150 lbs. per acre, and those plots to which superphosphate only was applied were treated as controls. Comparisons were made between these control plots and those plots receiving 1 cwt. and 2 cwts. of sulphate of ammonia respectively. With each of these dressings the whole of the fertiliser was applied at the one time, viz., at seeding, in the one instance, and also, in separate plots, the application of half of the sulphate was delayed until the month of August.

All the plots, which were each one-eighth of an acre in area, were repeated five times.

This experiment was conducted on fallowed and unfallowed land. The fallowed plots were ploughed in July, 1929, to a depth of 4 inches with a disc plough, and reploughed in August and springtyne cultivated after rain in March. The unfallowed plots were ploughed after early rains in March. Both the fallowed and unfallowed land were then springtyne cultivated in April and tandem disc cultivated prior to planting on 23rd May.

A good even germination was obtained.

The results were as follows:—

NITROGEN EXPERIMENT.

Fallow Section.

Planted on 23rd May, 1930. Variety—Gluyas Early. Superphosphate—150lbs. per acre.
Seed—45lbs. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
1 cwt. at Seeding ...	26 56	28 16	30 24	27 12	30 32	28 40	102	101
Nil	26 56	28 40	28 56	26 32	29 36	28 8	100	100
2 cwt. at Seeding ...	29 4	29 36	29 4	28 56	29 20	29 12	104	104

Fallow Section.

Planted on 23rd May, 1930. Variety—Gluyas Early. Superphosphate—150lbs. per acre.
Seed—45lbs. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
½-cwt. at Seeding; ½-cwt. in August	27 4	29 4	28 56	30 40	29 20	29 1	101	100
Nil	26 56	29 28	28 56	29 4	28 40	28 37	100	100
1 cwt. at Seeding; 1 cwt. in August	28 48	29 12	30 32	29 36	29 44	29 34	100	103

Non-Fallow Section.

Planted on 23rd May, 1930 Variety—Gluyas Early. Superphosphate—150lbs. per acre.
Seed—45lbs. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre.					Average Yields per acre, 1930	Percentage Yields, 1930.	Percentage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
1 cwt. at Seeding ...	32 8	31 28	28 56	26 24	30 48	29 57	106	97
Nil	29 44	30 8	28 16	28 24	25 4	28 19	100	100
2 cwt. at Seeding ...	29 44	28 8	30 8	31 28	28 56	29 41	105	102

Non-Fallow Section.

Planted on 23rd May, 1930. Variety—Gluyas Early. Superphosphate—150lbs. per acre.
Seed—45lbs. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre.					Average Yields per acre, 1930	Percentage Yields, 1930.	Percentage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
½-cwt. at Seeding; ½-cwt. in August	29 36	30 48	26 56	28 56	29 20	29 7	100	101
Nil	29 36	31 4	27 36	28 32	29 4	29 10	100	100
1 cwt. at Seeding; 1 cwt. in August	30 24	28 32	29 12	29 12	31 20	29 44	102	103

The results obtained over the two years that the experiment has been conducted indicate that the applications of heavy dressings of ammonium sulphate do not give any significant increase in the yields either from fallowed or unfallowed land.

FIELD EXPERIMENTS WITH WHEAT, 1930.

CHAPMAN EXPERIMENT FARM.

I. THOMAS, Superintendent of Wheat Farms,
and
F. L. SHIER, B.Sc. (Agric.), Farm Manager.

The following experiments, in addition to those published in the March issue of the *Journal*, were conducted at the Chapman Experiment Farm last year:—

Time of Ploughing.
Depth of Ploughing.
Mulching.
Nitrogen.

The land in which the experiments were conducted varied from typical jam (*Acacia acuminata*) country to that of lighter timber country and had been cleared some years previously.

The past season was a rather adverse one for wheat-growing at this farm. The total rainfall for the year was 1,965 points, of which 1,856 points fell during the growing period. Such a heavy rainfall during these months has only been exceeded previously four times in twenty-five years.

The following is the rainfall for 1930, together with the 25 years' average:—

Year.	Jan.	Feb.	Mar.	Apl.	Growing Periods.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1930	...	...	34	57	117	915	460	159	121	84	1,856	14	4	1,965
Average, 25 years ...	26	48	65	44	234	438	399	263	162	96	1,592	29	22	1,826

No rain of any consequence fell until 9th May, and in view of past experience it was necessary to delay seeding until the rains had germinated the weed seeds. As an indication of the lateness of the season less than half the average rainfall for the period January-May had been recorded by the end of May. No less than 915 points fell during June, resulting in boggy and water-logged soil conditions which further delayed seeding operations and retarded the growth of crops already planted, particularly those in the low-lying portions of the paddocks. July was also a very wet month, but with the advent of warmer and drier conditions in August the growing conditions improved.

Time of Ploughing Experiment, 1930.

The object of this experiment, which has been conducted for the past two years, is to ascertain whether the time of carrying out the initial operation of fallowing, *i.e.*, ploughing, has any effect upon the yields of the resultant crop.

For the purpose of the experiment, three sets of plots were required—

Plot 1—Ploughed in March (long summer fallow).
Plot 2—Ploughed in June (early winter fallow).
Plot 3—Ploughed in Auguust (late winter fallow.)

The plots, each one-eighth of an acre in area, were repeated five times.

All plots were ploughed to a depth of 4 inches at the respective times. The March plots were springtyne cultivated in June, on account of weed growth, and the whole experiment was cultivated in September, and again prior to seeding on 16th May.

The variety Nabawa was sown at the rate of 60 lbs. per acre, superphosphate being applied at the rate of 112 lbs. per acre.

The results obtained are as hereunder:—

TIME OF PLOUGHING EXPERIMENT.

Planted on 16th May, 1930. Variety—Nabawa. Seed—60lbs. per acre. Superphosphate—112lbs. per acre.

Time of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Per-centage Yields, 1930.	Average Yields per acre, 1929–30.	Per-centage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
26th March, 1929 ...	10 32	9 36	8 56	10 16	10 0	9 52	92	9 58	90
22nd June, 1929 ...	9 52	10 0	9 20	11 28	13 12	10 46	100	11 6	100
12th August, 1929 ...	9 52	10 0	11 28	12 16	12 48	11 17	105	10 6	91

The results are for two years only and hence cannot be taken as conclusive. The average results indicate that the best returns are obtained from early winter fallow.

Depth of Ploughing Experiment.

The object of this experiment, which has been conducted since 1915, is to determine the most economical depth of ploughing for wheat growing on fallowed land.

Three plots were required and were ploughed as follows:—

Plot 1—4 inches, representing shallow ploughing.
Plot 2—6 inches, representing medium ploughing.
Plot 3—8 inches, representing deep ploughing.

The plots, which were each one-eighth of an acre in area, were repeated five times.

The land on which the experiment was conducted originally carried jam and wattle. It was ploughed during June, 1929, with a mouldboard plough and springtyne cultivated in August and September, and again prior to seeding.

The variety Nabawa was planted on 16th May at the rate of 60 lbs. per acre, superphosphate being applied at the rate of 112 lbs. per acre.

The results obtained are as follows:—

DEPTH OF PLOUGHING EXPERIMENT, 1930.

Variety—Nabawa. Planted on 16th May, 1930. Superphosphate—112lbs. per acre.
Seed—60lbs. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1915–30.	Percentage Yields, 1915–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
4 inches	15 44	17 52	16 0	16 48	16 32	16 35	88	15 6	99
6 ,, ...	15 44	19 28	20 32	20 0	18 24	18 50	100	15 14	100
8 ,, ...	19 44	20 32	16 56	19 44	20 16	19 26	103	15 43	103

The results this year, as they have been for the past two years, are in favour of the deeper ploughing. However, the average results since the inception of the experiment in 1915, show that the most economical depth to plough this class of country is 4 inches. They also show that the yields are not decreased when the land is ploughed deeper.

Mulching Experiment, 1930.

The object of this experiment is to determine to what extent the cultivation of winter fallowed land is profitable during the spring and summer months.

The experiment has been conducted since 1914, and, as in previous years, the following system of cultivation was adopted.

Plot 1 (well worked fallow): Cultivated during spring, when required during summer after 25 points of rain or over, and again prior to seeding, the object being to maintain a mulch throughout the fallowed period and to destroy weed growth.

Plot 2 (ordinary fallow—control): Cultivated during spring and prior to seeding only.

Plot 3 (neglected fallow): Cultivated prior to seeding only.

The land was ploughed in July, 1929, and the plots were cultivated as follows:—Plot 1 was cultivated in September, November, March, April and before seeding, *i.e*, five times. Plot 2 was cultivated in September and prior to seeding, and Plot 3 was cultivated before seeding only. All plots were repeated five times. The results for this year and the average results for 1930 are as follows:—

MULCHING EXPERIMENT.

Planted on 21st May, 1930. Variety—Nabawa. Superphosphate—112lbs. per acre.
Seed—60lbs. per acre.

Cultivations.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1914–30.	Percentage Yields, 1914–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Mulched in spring, after rains during summer, and before seeding	10 0	9 52	9 52	10 0	10 32	10 3	100	14 47	108
Mulched in spring, and before seeding (Control)	10 0	10 16	10 8	10 8	9 44	10 3	100	13 44	100
Mulched before seeding only	12 32	9 36	9 36	10 0	9 44	10 18	102	12 39	92

The difference in yields in the plots this year is not significant. The average results for the sixteen years that the experiment has been conducted indicate, however, that the most economical working of the fallow is to cultivate in spring and prior to seeding. It is pointed out, however, that where weeds are bad, it is advisable to make use of summer rains to destroy weeds by cultivation.

Nitrogen Experiment, 1930.

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of a nitrogenous fertiliser are applied to the wheat crop in addition to an application of superphosphate.

For the purposes of the experiment two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwt. respectively.

Superphosphate was applied to all plots at the rate of 112 lbs. per acre, and those plots to which superphosphate only was applied were treated as controls. Comparisons were made between these control plots and those plots receiving 1 cwt. and 2 cwt. of sulphate of ammonia respectively. With each of these dressings the whole of the fertiliser was applied at the one time, viz., at seeding.

The experiment was conducted on both fallowed and unfallowed land, all plots being repeated five times. The fallowed land was ploughed in August, 1929, with a mouldboard plough and springtyne cultivated during September and again prior to seeding. The unfallowed land was mouldboard ploughed on June 2nd, 1930, and then harrowed, and all plots were seeded on 6th June, the variety Nabawa being sown at the rate of 60 lbs. of seed and superphosphate applied at 112 lbs. per acre.

The results obtained are shown hereunder:—

NITROGEN EXPERIMENT.

FALLOW.

Variety—Nabawa. Planted on 6th June, 1930. Superphosphate—112lbs. per acre.
Seed—60lbs. per acre.

Rate of Application of Ammonium Sulphate per acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
1 cwt.	6 16	6 32	7 28	7 52	8 40	7 22	100	109
Nil	6 48	7 28	6 56	7 44	7 44	7 20	100	100
2 cwt.	7 12	6 24	7 12	7 28	7 12	7 6	96	105

NON-FALLOW.

Variety—Nabawa. Planted on 6th June, 1930. Superphosphate—112lbs. per acre.
Seed—60lbs. per acre.

Rate of Application of Ammonium Sulphate per acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
1 cwt.	10 40	11 44	8 56	9 4	10 0	10 5	133	117
Nil	8 56	8 24	6 56	6 24	7 12	7 34	100	100
2 cwt.	10 8	9 36	8 24	8 40	8 16	9 1	119	133

As this experiment has been conducted for two years only, no definite conclusions can be arrived at. The average results indicate that on this class of soil the nitrogenous fertiliser produces greater increased yields on the unfallowed than on the fallowed land. On both sections this year, plots receiving at the rate of 2 cwt. of nitrogenous fertiliser did not yield as well as those plots receiving a dressing of 1 cwt.

FIELD EXPERIMENTS WITH WHEAT, 1930.

WONGAN HILLS LIGHT LANDS FARM.

I. THOMAS, Superintendent of Wheat Farms, and
A. R. VENTON, Farm Manager.

The following experiments with potash and nitrogenous fertilisers were conducted at the Wongan Hills Light Lands Farm during 1930, in addition to those published in the March issue of the Journal.

The past season was more favourable for the growth of the crop than that of the previous year; although the rainfall was again below the average, it was more evenly distributed.

The following table shows the monthly rainfall for 1929 and 1930 as recorded at the farm, together with the averages for the past 17 years as officially recorded at the Wongan Hills township, four miles distant.

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for Year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1930	7	...	53	92	66	367	321	149	90	55	1,048	1	98	1,299
1929	22	217	85	...	261	426	172	140	35	141	1,175	38	4	1,541
17 years' average ...	44	55	97	62	196	306	273	195	126	94	1,191	41	49	1,538

Useful rains fell in April, and those varieties planted during that month obtained a good start. The latter part of May was warm and dry, and as a result a little malting occurred in those portions of the crop planted after the first week in May.

The land on which the experiments were conducted was virgin country prior to being fallowed in 1929, consisted mainly of the smokebush and tussocky types of sand plain. It was ploughed from June to early August, 1929, with a disc implement (Sundercut), cross cultivated with the same implement during August and September, and again cultivated with the same implement in March and early April. Prior to seeding it was tandem disc cultivated. Excepting where the requirements of an experiment necessitated otherwise, the cultural details for all the experiments were as outlined.

Potash Experiment, 1930.

The object of this experiment is to determine whether any advantage is derived by supplementing the dressing of superphosphate with a potassic manure for growing a wheat crop on light land.

Three fertilisers were used and were applied as follows:—

Plot 1—150 lbs. superphosphate + 56 lbs. muriate of potash per acre.
Plot 2—150 lbs. superphosphate per acre (control).
Plot 3—150 lbs. superphosphate + 140 lbs. kainit per acre.

This section of plots, each one-eighth of an acre, was repeated five times. The quantity of potash stated as K_2O is the same in 56 lbs. of the muriate as in 140 lbs. of the kainit.

The potassic fertilisers were applied to the respective plots about four weeks before seeding. This course is considered advisable owing to the risk of injuring the young plants incurred by applying a fertiliser of this type at seeding time.

Germination was fairly even, growth throughout the season was healthy, and at no time during the season could any difference be discerned between the plots.

Unfortunately harvesting operations on this experiment were interrupted by heavy rain and strong wind. The five plots which were harvested after the storm had lodged somewhat and only the results of three sections harvested prior to the storm were used for comparison.

Mixed Fertiliser Experiment.

Planted on 29th April, 1930. Variety—Nabawa. Superphosphate—150lbs. per acre.
Seed—45lbs. per acre.

Potash applied per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1927–30.	Percentage Yields, 1927–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Muriate of Potash, 56lb.	†	†	16 24	15 44	16 40	16 16	98	15 18	99
No Potash	†	†	16 40	16 8	16 56	16 35	100	15 26	100
Kainit, 140lb. ...	†	15 20	16 8	16 24	16 24	16 19	98	15 26	100

† Plots damaged by heavy weather. Only Sections 3, 4, and 5 used in calculations.

The results of this year and also the average results for the four years during which the experiment has been conducted, show that the yields are not increased by applying a potassic fertiliser to this class of soil.

Nitrogen Experiment, 1930.

The objects of this experiment which was carried out on fallowed and unfallowed land are:—

(a) To determine whether increased yields are obtained when heavy dressings of sulphate of ammonia are applied to the wheat crop in addition to an application of superphosphate, and

(b) To ascertain whether it is advantageous to apply only part of this nitrogenous fertiliser at seeding time and part during the month of August (spring).

For the purposes of the experiment, two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwts. respectively.

Superphosphate was applied to all plots at the rate of 150 lbs. per acre, and those plots to which superphosphate only was applied were treated as controls. Comparisons were made between these control plots and those plots receiving 1 cwt. and 2 cwts. of sulphate of ammonia per acre respectively. With each of these dressings the whole of the fertiliser was applied at the one time, viz., at seeding, in the one instance, and also, in separate plots, the application of half of the sulphate was delayed until the month of August.

The fallowed land was of the smokebush type of country and was ploughed in June-July, 1929, with a disc cultivating plough and cross cultivated in October with the same implement. In January it was scrub-raked and in March disc cultivated and tandem disced prior to seeding on 24th April, 1930.

The non-fallowed land was ploughed a few days prior to seeding on 7th May.

Germination was good on both the fallow and non-fallow sections. From the end of May onwards the plots treated with the sulphate of ammonia appeared more robust. A very marked difference was also apparent between the affects of the various dressings of the nitrogenous fertiliser. As the season advanced this difference became more apparent, the plots being denser and taller according to the quantity of sulphate of ammonia used. The additional dressings, however, at the end of August made no visible difference. In the fallowed section, the control plots matured seven to eight days later than the remainder and on the non-fallow six to seven days later.

It was noticed on both sections that those dressed with nitrogenous fertilisers lodged at maturity, this being more pronounced on the fallow section where the growth was more rank.

No difference could be observed in the growth of the plots which were top-dressed in August.

The results obtained are as follows:—

NITROGEN EXPERIMENT.

NON-FALLOW SECTION.

Planted on 7th May, 1930. Variety—Nabawa. Superphosphate—150lbs. per acre.
Seed—45lbs. per acre.

Rate of application of Sulphate of Ammonia per acre.	Computed Yields per acre.										Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929–30.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.				
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus. lbs.	%	%
56lbs. at seeding; 56lbs. in August	18	48	17	4	17	44	18	0	16	56	17 42	106	116
Nil	16	0	15	36	17	12	17	52	16	56	16 43	100	100
112lbs. at seeding; 112lbs. in August	17	12	17	36	17	28	16	32	16	32	17 4	102	112

NON-FALLOW SECTION.

Planted on 7th May, 1930. Variety—Nabawa. Superphosphate—150lbs. per acre.
Seed—45lbs. per acre.

Rate of application of Sulphate of Ammonia per acre.	Computed yields per acre.										Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929–30.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.				
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus. lbs.	%	%
112lb. at Seeding ...	17	36	18	8	17	44	17	28	16	56	17 34	100	111
Nil	16	8	18	8	18	48	17	44	17	20	17 38	100	100
224lb. at Seeding ...	15	12	16	56	15	44	16	8	17	20	16 16	92	108

FALLOW SECTION.

Planted on 24th April, 1930. Variety—Nabawa. Superphosphate—150lbs. per acre.
Seed—45lbs. per acre.

Rate of application of Sulphate of Ammonia per acre.	Computed Yields per acre.										Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929–30.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.				
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus. lbs.	%	%
112lbs. at Seeding ...	22	0	21	52	19	44	20	24	21	28	21 6	132	146
Nil	16	56	16	0	14	32	16	16	15	52	15 55	100	100
224lbs. at Seeding ...	21	52	22	8	21	12	21	36	24	8	22 11	139	146

FALLOW SECTION.

Planted on 24th April, 1930. Variety—Nabawa. Superphosphate—150lbs. per acre.
Seed—45lbs. per acre

Rate of application of Sulphate of Ammonia per acre.	Computed Yields per acre.					Average Yields per acre 1930.	Percentage Yields, 1930.	Percentage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
56lbs. at Seeding; 56lbs. in August	18 56	19 20	22 0	21 4	20 48	20 26	124	131
Nil	15 28	16 8	16 48	17 12	16 32	16 26	100	100
112lbs. at Seeding; 112lbs in August	20 32	20 40	22 0	22 0	22 24	21 31	131	142

The results on the fallowed plots show that a dressing of nitrogenous manure when applied at seeding time gives greater yields than when portion is applied at seeding and the balance during spring, and there is, apparently, no benefit to be obtained by increasing these dressings above 1 cwt. per acre. This experiment has been carried out for two years only, and these conclusions need further confirmation before they can be accepted.

The results do, however, demonstrate that this class of soil is very deficient in nitrogen.

FIELD EXPERIMENTS WITH WHEAT, 1930.

SALMON GUMS EXPERIMENT FARM.

I. Thomas, Superintendent of Wheat Farms,
and
L. G. Seinor, Farm Manager.

The following experiments were conducted at the Salmon Gums Experiment Farm during 1930 in addition to those published in the March issue of the *Journal*:—

Time of ploughing.
Depth of ploughing.
Mulching.
Nitrogen.

The rainfall for the greater part of the past season was favourable for the growth of the wheat crops. The heavy rains which fell in March facilitated the preparation of a good seed bed in addition to assuring reserves of moisture in the subsoil. Seeding operations were carried out under ideal conditions, and the germination of the seed was excellent. Favourable growing conditions continued until the end of August. Light falls were recorded during September, but the crops did not derive full advantage from these because of the drying winds which were later experienced.

The monthly rainfall, as recorded at the farm for both years 1930 and 1929, together with the average for the past 12 years as recorded at Salmon Gums, one mile distant, is as follows:—

—	Jan.	Feb.	Mar.	Apl.	Growing Periods.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
At Farm, 1930 ...	...	...	312	162	269	156	92	230	73	17	837	14	298	1,623
At Farm, 1929 ...	106	65	73	26	125	207	159	163	21	35	710	150	43	1,173
Average, 1926–30 ...	33	35	203	99	133	113	139	167	80	88	720	40	74	1,204
Salmon Gums Town, 1919–30	29	46	128	113	165	151	132	141	110	113	812	75	98	1,301

The area on which the experiments were planted, originally carried silver mallee, silver bark, tea tree and other light mallee, and was cleared in 1926, fallowed 1927, and cropped in 1928. In preparation for the planting this year it was ploughed to a depth of 4in. with a disc-cultivating plough in June-July, 1929, cross ploughed in November, springtyne cultivated in January, and prior to seeding.

Time of Ploughing Experiment, 1930.

The object of this experiment is to ascertain whether the time of carrying out the initial operation of fallowing, *i.e.*, ploughing, has any effect upon the yields of the resultant wheat crop.

Three plots, treated in the following manner, were required:—

Plot 1.—Ploughed in March, 1929. (Long summer fallow.)
Plot 2.—Ploughed in June, 1929. (Early winter fallow.)
Plot 3.—Ploughed in September, 1929. (Late winter fallow.)

Each plot was repeated five times.

The land on which the experiment was conducted was cleared in 1927 of its original vegetation of gimlet-mallee, silver bark and tea tree scrub. It was fallowed in 1927, cropped in 1928 and then ploughed according to the requirements of the experiment in 1929.

All plots were cultivated in November and again prior to seeding.

The results obtained are set out hereunder:—

TIME OF PLOUGHING EXPERIMENT. 1930.

Variety.—Nabawa. Planted on 6th May. Superphosphate.—112 lbs. per acre. Seed.—45 lbs. per acre.

Time of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928–30.	Percentage Yields, 1928–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
March.									
Long summer fallow ...	13 4	11 52	12 0	12 8	11 36	12 8	92	12 30	96
June.									
Early winter fallow ...	14 8	12 16	12 48	13 4	13 52	13 14	100	13 3	100
September.									
Late winter fallow ...	12 56	11 52	12 0	12 0	12 0	12 10	92	12 6	93

The results obtained this year and the average results for the past three years indicate that the early winter ploughing gives the best results. Thus ploughing should be commenced as soon as possible after seeding has been completed as the results indicate that the earlier the initial operation is completed during the winter months the better.

Depth of Ploughing Experiment, 1930.

The object of this experiment, which has been conducted for the past two years, is to determine the most economical depth to plough for the wheat crop.

Three plots, each repeated five times, were required, one ploughed to a depth of 2 inches, one to 4 inches and one to 5 inches. The type of implement available did not permit of the third plot being ploughed to a depth of 6 inches, as was originally intended.

The land on which the experiment was conducted originally carried gimlet mallee, silver bark and tea tree, and was cleared and fallowed in 1927, cropped 1928 and ploughed, according to the requirements of the experiments, in June, 1929. It was disc cultivated in November and springtyne cultivated in January and prior to seeding on May 7th.

Greater difficulty was experienced in obtaining a good seed-bed in the 2-inch ploughing than in the deeper ploughing. During the early stages of growth little difference in appearance could be detected in the various plots, but when the late spring rains were deficient the deeper ploughing showed to advantage.

The results obtained are set out below:—

DEPTH OF PLOUGHING EXPERIMENT. 1930.

Variety—Nabawa. Planted on 7th May, 1930. Superphosphate—112lbs. per acre. Seed—45lbs. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929–30.	Percentage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
2 inches	11 12	11 52	10 24	11 4	11 28	11 12	87	12 14	90
4 ,, ...	12 0	12 56	13 44	12 16	13 44	12 56	100	13 32	100
,, ...	11 52	12 56	13 44	12 8	13 36	12 51	99	13 0	96

Although no definite conclusion can be arrived at from the result of two years' experiments, there is an indication in this and the previous year's results that 4 inches is sufficient depth to plough. In this district, where mallee stumps are abundant, it will be found that by ploughing to a depth of 4 inches a greater proportion of stumps can be removed than by shallow ploughing. With the shallow ploughing also, it is difficult to maintain a suitable mulch and prepare a good seed bed.

Mulching Experiment, 1930.

The object of this experiment is to determine how far and under what conditions the cultivation of winter fallowed land during the spring and summer months is profitable.

For this purpose three plots were required.

Plot 1.—Cultivated during spring, again during summer after 25 points of rain or over, and again before seeding, the object being to maintain a mulch during the fallowed period and to destroy weed growth.

Plot 2.—Cultivated during spring and prior to seeding only.

Plot 3.—Cultivated prior to seeding only.

Each plot was repeated five times, the experiment being conducted on land which was ploughed in June, 1929.

The variety Nabawa was planted on 3rd May, 1930, at the rate of 45 lbs. per acre. Superphosphate was applied at the rate of 112 lbs. per acre.

The results are tabulated below:—

MULCHING EXPERIMENT, 1930.

Variety—Nabawa. Planted on 3rd May, 1930. Superphosphate—112lbs. per acre. Seed—45lbs. per acre.

Treatment.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929–30.	Percentage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Cultivated in spring, after summer rains and before seeding	13 36	12 16	12 8	12 24	*	12 36	105	13 21	104
Cultivated in spring, and before seeding	10 8	12 56	12 24	12 24	*	11 58	100	12 52	100
Cultivated before seeding only	12 0	11 52	12 48	13 20	*	12 30	104	13 15	103

* Discarded owing to accident at seeding.

No definite conclusions can be arrived at, as this experiment has only been conducted for two years.

Nitrogen Experiment, 1930.

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of sulphate of ammonia are applied to the wheat crop in addition to an application of superphosphate.

For the purpose of the experiment, which was conducted on both fallowed and unfallowed land, two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwt. respectively. Superphosphate was applied to all plots at the rate of 1 cwt. per acre, and those plots to which superphosphate only was applied were treated as controls. The whole of the fertiliser was applied at seeding time, all plots being repeated five times.

The land for the fallowed section was ploughed in June, 1929, disc cultivated in October, springtyne cultivated in November and again prior to seeding.

The unfallowed land which had been cropped two years previously, was only springtyne cultivated prior to seeding.

All plots were planted on 9th May, 1930, the variety Nabawa being sown at the rate of 45 lbs. per acre.

The plots to which the nitrogenous fertiliser was applied showed to advantage during the winter, being easily distinguished by the density of growth and the dark green colour of the flag. They made better growth until the spring when, owing to the dry weather conditions, they suffered more than the control plots.

The results obtained are set out below:—

NITROGEN EXPERIMENT, 1930.

FALLOW SECTION.

Variety—Nabawa. Planted on 9th May, 1930. Superphosphate—112lbs. per acre. Seed—45lbs. per acre.

Rate of Application of Ammonium Sulphate per acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Percentage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.			
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	%
1 cwt.	12 16	14 24	14 24	13 4	14 24	13 42	92	95
Nil	16 0	14 40	15 4	14 16	14 40	14 56	100	100
2 cwt.	13 28	14 8	12 48	13 44	12 48	13 23	90	90

NON-FALLOW SECTION.

Variety—Nabawa. Planted on 9th May, 1930. Superphosphate—112lbs. per acre. Seed—45lbs. per acre.

Rate of Application of Ammonium Sulphate per acre.	Computed Yields per Acre.					Average Yields per Acre. 1930.	Percentage Yields 1930.
	Section 1.	Section 2.	Section 3.	Section. 4	Section 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
1 cwt.	10 56	12 16	12 40	12 40	11 36	12 2	95
Nil	12 48	12 56	12 48	12 8	12 48	12 42	100
2 cwt.	12 56	12 0	12 48	12 16	11 36	12 19	97

Although these results are for two years only they indicate that there is no advantage in using heavy dressings of sulphate of ammonia either on fallowed or unfallowed land of this nature.

FIELD EXPERIMENTS WITH WHEAT, 1930.

YILGARN EXPERIMENT FARM.

I. THOMAS, Superintendent of Wheat Farms.

In addition to the experiments published in the March issue of the *Journal* the following experiments were conducted at the Yilgarn Experiment Farm during 1930:—

Time of Ploughing.
Depth of Ploughing.
Mulching.
Nitrogen.

Since cropping operations have been carried out at the farm (these commencing in 1929), the rainfall during the growing periods has been below that of the average for Southern Cross (a distance of 8 miles West) for the past 40 years.

The monthly registrations at the farm for 1930, together with the average for the past three years, and the average as recorded at Southern Cross for the past 40 years are set out hereunder:—

	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1930	...	167	62	209	87	229	88	110	45	9	568	10	173	1,189
Average 3 years ...	43	95	58	86	177	150	104	75	34	25	565	101	77	1,025
Southern Cross average, 40 years ...	49	61	107	79	138	141	145	110	80	61	675	43	46	1,060

Following good rains during the months of February and March, copious rains were experienced in April, resulting in the subsoil becoming well supplied with moisture. These April rains caused seeding operations to be delayed, but after the first week in May no further rain was recorded during that month, which enabled seeding to be proceeded with without interruption. Some anxiety, however,

was caused by this prolonged dry period, as it was feared that malting of the seed would occur in the crops sown after the middle of May. This anxiety was relieved, by rains early in June. During the remainder of that month further good rains were recorded and owing to the mild climatic conditions which prevailed during July and August, the crops made vigorous growth. Unfortunately these favourable growing conditions did not continue into September. During this month the rainfall was scanty and several severe frosts occurred, combined with hot drying conditions during the day, which affected the crops. Little or no rain was experienced in October, so that they matured under adverse conditions, when it became apparent that the yields of earlier expectations would not be realised.

The land on which the experiments were conducted was originally timbered with salmon gum and gimlet, and was cleared in 1928. During June and July, 1929, in preparation for planting, it was ploughed with a disc cultivating plough to a depth of 4 inches. In September it was cultivated with a springtyne implement and was again cultivated with the same implement in February, after rain and prior to seeding.

Unless otherwise stated, these cultural operations refer to the land on which the experiments set out below were planted.

Time of Ploughing Experiment, 1930.

The object of this experiment is to determine to what extent the time of ploughing affects the yields of the resulting crop.

For this experiment, three plots were required:—

Plot 1—Ploughed in March (long summer fallow).

Plot 2—Ploughed in June (early winter fallow).

Plot 3—Ploughed in August (late winter fallow).

Each plot was repeated five times. Subsequent to the initial operation of ploughing, the plots were springtyne cultivated in September and prior to seeding, which took place on May 6th. Portion of the seed germinated on May 14th, the balance not until after rain on June 7th.

The results are set out below:—

TIME OF PLOUGHING EXPERIMENT.

Planted on 6th May, 1930. Variety—Gluyas Early. Superphosphate—112lbs. per acre.
Seed—30lbs. per acre.

Time of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929–30.	Percentage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
March, 1929	10 8	15 44	9 4	13 52	14 8	12 35	83	10 35	86
June, 1929	14 32	16 8	16 48	13 44	14 24	15 7	100	12 18	100
August, 1929 ...	16 16	15 36	10 40	9 52	14 32	13 23	89	10 19	84

The results are for two years only, so that no definite conclusions can be arrived at. However, they are in conformity with similar experiments conducted at the other experiment farms, and stress the value of early winter fallow.

Depth of Ploughing Experiment, 1930.

The object of this experiment is to ascertain the comparative effect upon the resultant wheat crop of ploughing the land to different depths.

For the purpose of the experiment three plots were required, and were ploughed as follows:—

Plot 1—2 inches, representing shallow ploughing.
Plot 2—4 inches, representing medium ploughing.
Plot 3—6 inches, representing deep ploughing.

The plots were each one-eighth of an acre in area and were repeated five times. They were ploughed to the respective depths with a disc implement in June, 1929, and all the plots were springtyne cultivated during September and prior to seeding, which took place on 6th May. The variety Gluyas Early was sown at the rate of 30 lb. per acre and superphosphate was applied at the rate of 112 lb. per acre.

The results are as hereunder:—

DEPTH OF PLOUGHING EXPERIMENT.

Planted on 6th May, 1930. Variety—Gluyas Early. Seed—30lbs. per acre. Superphosphate—112lbs. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1929–30.	Percentage Yields, 1929–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
2in. deep	16 24	16 16	16 16	15 28	10 40	15 1	103	11 11	101
4in. deep	14 48	14 56	14 24	14 8	14 32	14 34	100	11 6	100
6in deep	15 20	12 32	13 4	11 44	11 4	12 45	88	10 34	95

As the experiment has been conducted for two years only, no definite conclusion can be arrived at. Although a slight increased yield was obtained from the shallow ploughing this season, it is considered advisable on account of the difficulty in maintaining the mulch during the summer on the 2-inch ploughing to plough to a greater depth.

Mulching Experiment, 1930.

The object of this experiment is to determine how far, and under what conditions, the working of winter fallowed land is profitable during the spring and summer months.

Three plots were necessary to meet the requirements of the experiment, and they were treated as follows:—

Plot No. 1 (Well worked fallow).—Cultivated during spring, again when required during summer, after 25 points of rain or over, and again prior to seeding, the object being to maintain a mulch throughout the fallowed period and to destroy weed growth.

Plot No. 2 (Ordinary fallow).—Cultivated during spring and prior to seeding only.

Plot No. 3 (Neglected fallow).—Cultivated prior to seeding only.

Plot 1 this year received cultivations with a springtyne cultivator in September, February, March, and prior to seeding. Plot 2 was cultivated in September and prior to seeding, while Plot 3 was cultivated prior to seeding only.

The variety Gluyas Early was planted on 7th May, 1930, at the rate of 30 lb. of seed per acre, superphosphate being applied at the rate of 112 lb. per acre.

The results obtained are shown hereunder:—

MULCHING EXPERIMENT.

Planted on 7th May, 1930. Variety—Gluyas Early. Seed—30lbs. per acre. Superphosphate—112lbs. per acre.

Treatment.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.	Average Yields per acre, 1928–30.	Percentage Yields, 1928–30.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4	Sec. 5.				
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%	bus. lbs.	%
Cultivated in Spring after Summer rains and before seeding	16 16	13 52	14 24	15 12	15 12	14 59	111	15 14	109
Cultivated in Spring and before seeding	12 56	12 48	12 32	14 56	14 32	13 33	100	13 56	100
Cultivated before seeding only	13 36	13 44	14 0	14 8	15 12	14 8	104	14 7	101

This year's results and the average results for three years indicate that higher yields are obtainable when the fallow is cultivated after rain during spring and summer months.

Nitrogen Experiment, 1930.

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of sulphate of ammonia are applied to the wheat crop in addition to an application of superphosphate.

For the purpose of the experiment, two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwt. respectively, while a third plot which received no sulphate of ammonia was used as a control plot. Superphosphate was applied at the rate of 112 lbs. per acre to all plots, which were repeated five times.

The experiment is slightly modified this year, as it is planted on fallowed as well as unfallowed land.

The fallow section was ploughed with a disc implement in June, 1929, and was springtyne cultivated in September and prior to seeding.

The unfallowed land was ploughed to a depth of 3 ins. in April and springtyne cultivated immediately before seeding.

The experiment was planted on 9th May, the variety Gluyas Early being sown at the rate of 30 lbs. per acre and superphosphate applied to all plots at the rate of 112 lbs. per acre.

The results obtained are tabulated hereunder:—

NITROGEN EXPERIMENT.

Non-Fallow Section.

Planted on 9th May, 1930. Variety—Gluyas Early. Seed—30lbs. per acre. Superphosphate—112lbs. per acre.

Rate of Application of Sulphate of Ammonia per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
112lb.	13 44	11 44	12 0	13 4	12 56	12 42	97
Nil	13 20	12 32	13 4	12 48	13 28	13 2	100
224lb.	11 44	10 56	12 32	11 36	12 32	11 52	91

Fallow Section.

Planted on 9th May, 1930. Variety—Gluyas Early. Superphosphate 112lbs. per acre.
Seed—30lbs. per acre.

Rate of Application of Sulphate of Ammonia per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
112lb.	19 36	19 20	17 12	18 24	16 24	18 11	106
Nil	16 24	18 0	17 20	17 28	16 56	17 14	100
224lb.	20 32	16 24	18 32	18 24	15 12	17 49	103

The experiment has been conducted on fallowed land for two years and on the unfallowed land once, so that, as yet, no definite conclusions can be arrived at

The results show that on the plots where sulphate of ammonia was applied in addition to superphosphate, the yields obtained from the unfallowed section were lower than when only superphosphate was applied. These results were reversed from the fallowed section. In both sections, the plots receiving dressings of 1 cwt. of sulphate of ammonia gave higher yields than those receiving double this dressing.

FIELD EXPERIMENTS WITH WHEAT, 1930.

DAMPAWAH EXPERIMENT FARM.

I. THOMAS, Sperintendent of Wheat Farms,
and
F. GISHUBL, Farm Manager.

The following experiments were conducted at the Dampawah Experiment Farm during 1930, in addition to those published in the March issue of the *Journal*:—

Fallow and Non-Fallow.
Time of Ploughing.
Depth of Ploughing.
Mulching.
Nitrogen.

The farm is situated 30 miles East of Perenjori, being formerly a portion of Karara Station, on the fringe of the Lower Murchison.

The soil is a red friable loam, uniform in appearance, and was originally timbered mainly with york gum, giant mallee, karara, and mulga scrub.

This is the first crop grown on this land, which was cleared during 1928 and the early part of 1929. After the burn a large quantity of ashes remained over the whole area. It was ploughed during the winter months (July-August) of 1929, with a disc cultivating plough 3-4 inches deep. Immediately after

ploughing it was cultivated with a springtyne implement. The seed was planted with a combined cultivator drill at the rate of 45 lbs. per acre. Superphosphate was applied at 112 lbs. per acre.

The following table shows the rainfall registered at the farm since it was established, together with the number of days on which rain fell during the year under review.

Year.	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for Year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1928	*	*	*	*	164	94	238	142	71	34	743	6	156	- †
1929	17	220	64	*Nil*	267	234	60	62	18	33	674	120	—	1,095
1930	—	—	93	123	48	404	160	93	22	41	768	31	54	1,069
No. of falls, 1930 ...	—	—	8	9	2	16	12	10	2	3	45	3	3	68

* No records. † Incomplete.

Although the rainfall during the growing period this year was greater than the previous year, the spring rains were somewhat similar, being scanty and insufficient for the crops to mature normally.

After a very dry period from the middle of November, 1929, 93 points of rain were recorded in March, spread over 8 days. Both before and after this rain hot dry weather conditions prevailed.

Prior to the middle of April, when 123 points of rain were recorded, no moisture could be detected in the subsoil as the rain which fell the previous month evaporated very rapidly. The registrations during the month of May were scanty and caused anxiety, as some of the crops already sown were above ground, and showed signs of distress and urgent need of rain.

The continuous and copious rains during June relieved the position, reviving patches of the crop on which the seed had appeared to have malted. There were, however, isolated patches which were affected by the seed malting.

Excellent growing conditions prevailed throughout July and the early part of August, and until the end of the third week of the latter month the crops looked very promising. Unfortunately the seasonable rains terminated abruptly at this time, resulting in the ears of the plants being unable to leave the sheath normally or wilting before reaching maturity. Harvesting of the crops for hay was commenced 16th September, and for grain on 23rd October.

Fallow and Non-Fallow Experiment, 1930.

The object of this experiment is to ascertain the effect upon the resulting wheat crop of sowing on fallowed and unfallowed land.

For the purpose of the experiment two sets of plots were required. The fallow plots were ploughed on 27th June, 1929, and were springtyne cultivated in September and prior to seeding. The unfallowed plots were ploughed on 14th April, 1930, and springtyne cultivated prior to seeding.

The plots, which were each one-eighth of an acre in area, were repeated five times.

The variety Gluyas Early was sown on 2nd May at the rate of 45 lbs. per acre, superphosphate being applied at the rate of 112 lbs. per acre.

The results are as hereunder:—

FALLOW *V.* NON-FALLOW EXPERIMENT.

Planted on 2nd May, 1930. Variety—Gluyas Early. Superphosphate—112lbs. per acre. Seed—45lbs. per acre.

Treatment.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Section 1.	Section 2.	Section. 3.	Section 4.	Section 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
Fallow	9 52	11 52	12 0	11 44	12 40	11 38	100
Non-Fallow	9 12	10 0	10 48	10 8	10 8	10 3	86

As this is the first year that the experiment has been conducted at this farm, no definite conclusion can be arrived at. They indicate, however, that increased yields are obtained from fallowed land.

Time of Ploughing Experiment, 1930.

The object of this experiment is to ascertain whether the time of carrying out the initial operation of fallowing, *i.e.* ploughing, has any effect upon the yield of the resultant wheat crop.

For the purpose of the experiment three plots were required:—

Plot 1. Ploughed in April.
Plot 2. Ploughed in June.
Plot 3. Ploughed in August.

All plots were repeated five times.

Subsequent to ploughing, all plots were springtyne cultivated in September and prior to seeding, which took place on 2nd May. The variety Gluyas Early was sown at the rate of 45 lbs. per acre and superphosphate applied at 112 lbs. per acre.

The results obtained are as follow:—

TIME OF PLOUGHING EXPERIMENT.

Planted on 2nd May, 1930. Variety—Gluyas Early. Superphosphate—112lbs. per acre. Seed—45lbs. per acre.

Time of Ploughing.	Computed Yields per Acre.					Average Yields per acre. 1930.	Percentage Yields,. 1930
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
April, 1929	13 52	12 8	13 12	12 8	14 48	13 13	98
June, 1929	13 36	13 44	13 4	12 48	14 32	13 33	100
August, 1929	12 8	11 52	12 24	13 12	12 8	12 21	91

From these results, which are for one year only, it would appear that the yields are increased when the land is ploughed during the early winter months and are in conformity with the results of somewhat similar experiments conducted at the other experiment farms.

Depth of Ploughing Experiment, 1930.

The object of this experiment, which was conducted for the first time last season, is to determine the comparative effects upon the resultant crop of ploughing the land to different depths.

For the purpose of the experiment three plots were required, and they were ploughed in July, 1929, at the respective depths of 2 inches, 4 inches and 6 inches, the whole experiment being repeated five times. The plots were spring-tyne cultivated in September and prior to seeding, which took place on 3rd May, the variety Gluyas Early being planted at the rate of 45 lbs. per acre and superphosphate applied at the rate of 112 lbs. per acre.

The results obtained were as follow:—

DEPTH OF PLOUGHING EXPERIMENT.

Planted on 3rd May, 1930. Variety—Gluyas Early. Seed—45lbs. per acre. Superphosphate—112lbs. per acre.

Depth of Ploughing.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
2in. deep	14 8	9 36	11 28	11 36	10 40	11 30	93
4in „	13 44	12 32	11 28	12 8	11 36	12 18	100
6in. „	13 4	12 48	12 16	11 28	10 48	12 5	98

As the experiment has been conducted for one year only, no definite conclusion can be stated, but the results agree with those of a similar experiment conducted at other experiment farms, which are that the most economical depth to plough is 4 inches.

Mulching Experiment, 1930.

This experiment is conducted in order to determine to what extent the cultivation of winter fallowed land is profitable during the spring and summer months.

Three plots were necessary to fulfil the requirements of the experiment. They were treated as follows:—

Plot 1.—Cultivated prior to seeding only (neglected fallow).

Plot 2.—Cultivated during spring and prior to seeding only (ordinary fallow).

Plot 3.—Cultivated during spring, again when required during summer after 25 points of rain or over, and again prior to seeding, the object being to maintain a mulch throughout the fallowed period and to destroy weed growth.

The soil on which the experiment was conducted was a red friable loam, the original timber being york gum and karara. This land was fallowed and cropped for the first time for this experiment.

All the plots were ploughed during July, 1929, and subsequently received the following cultivations with a springtyne implement.

Plot 1.—Cultivated before seeding only.

Plot 2.—Cultivated in September and before seeding.

Plot 3.—Cultivated in September, October, November, March, and prior to seeding in May.

The results obtained this season are as follow:—

MULCHING EXPERIMENT.

Planted on 5th May, 1930. Variety—Gluyas Early. Seed—45lbs. per acre. Superphosphate—112lbs. per acre.

Treatment.	Computed Yields per Acre.										Average Yields per acre, 1930.		Percentage Yields, 1930.	Average Yields per acre, 1929–30.		Percentage Yields, 1929–30
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.							
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%	bus.	lbs.	%
Cultivated before seeding only	10	40	8	32	11	4	10	56	11	36	10	34	104	16	17	102
Cultivated in Spring and before seeding	11	12	8	40	10	16	10	48	9	44	10	8	100	16	2	100
Cultivated in Spring during Summer after rain and before seeding	9	4	11	4	9	20	10	16	8	0	9	33	94	15	19	96

Although Plot No. 3 received three additional workings the results are no better than those from the plot worked after ploughing and before seeding only. However, the results are only for two years and cannot as yet be accepted as conclusive.

Nitrogen Experiment, 1930.

The object of this experiment is to determine whether increased yields are obtained when heavy dressings of nitrogenous fertiliser are applied to the wheat crop, in addition to an application of superphosphate.

For the purpose of the experiment two rates of sulphate of ammonia were applied, viz., 1 cwt. and 2 cwt. respectively.

Superphosphate was applied to all plots at the rate of 120 lbs. per acre and those plots, to which superphosphate only was applied, were treated as controls. Comparisons were made between these control plots and those receiving 1 cwt. and 2 cwt. of sulphate of ammonia respectively. The fertilisers were applied at seeding time. The plots were repeated five times, the whole experiment being sown on fallowed and unfallowed land.

The fallowed section was ploughed during June and July, 1929, to a depth of 4 inches and was cultivated with a springtyne cultivator in September and received no further cultivation, the experiment being planted with a combined cultivator drill.

The unfallowed section was ploughed 3-4 inches deep with a disc implement on 7th April, 1930, and received no further working until seeding, when it was planted with a combined cultivator drill.

The results obtained are shown hereunder:—

EXPERIMENT FARM, PERENJORI.

NITROGEN EXPERIMENT.

Fallow Section.

Planted on 9th May, 1930. Variety—Gluyas Early. Seed—45lbs. per acre. Superphosphate—120lbs. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre.										Average Yields per acre, 1930.		Percentage Yields, 1930.
	Section 1.		Section 2.		Section 3.		Section 4.		Section 5.				
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%
112lbs.	7	52	7	52	7	36	7	4	6	0	7	17	91
Nil	7	20	8	24	8	32	8	16	7	20	7	58	100
224lbs.	6	32	6	48	6	24	4	56	4	40	5	52	74

Non-Fallow Section.

Planted on 9th May, 1930. Variety—Gluyas Early. Seed—45lbs. per acre. Superphosphate—120lbs. per acre.

Rate of Application of Sulphate of Ammonia per acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Section 1.	Section 2.	Section 3.	Section 4.	Section 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
112lbs.	5 20	6 56	5 52	6 32	6 8	6 10	84
Nil	6 56	7 20	8 32	7 12	6 32	7 18	100
224lbs.	5 4	4 8	5 20	5 28	5 36	5 7	70

These results which are for two years in the case of the fallow section, and one year in the non-fallow section, indicate that no advantage is obtained by the application of a nitrogenous fertiliser to either fallowed or unfallowed land.

"DOWNY MILDEW" (SO-CALLED "BLUE MOULD") OF TOBACCO.

THE INDUSTRY'S MOST SERIOUS MENACE, AND HOW TO COMBAT IT.

H. A. PITTMAN, B.Sc. Agr.,
Plant Pathologist.

The disease known as "Downy Mildew," or more frequently, although less desirably, "blue mould" of tobacco, is the most disastrous disease with which the Australian tobacco-grower has to contend, wiping out, as it does with monotonous regularity year after year in the Eastern States, enormous numbers of plants in the seed-beds, and sometimes even after planting out.

The extremely serious nature of the trouble under favourable conditions may perhaps be best realised from the following quotations. In the "Report from the Select Committee on the Tobacco-growing Industry in Australia," 1929-30 (9), occurs the statement: "The growers have hitherto proved unable to deal with the blue mould disease, which in many cases wipes out the tobacco of a whole district two out of three seasons." Adam (1), writing in the Victorian Journal of Agriculture for July, 1925, stated: "Frequently a tobacco seed-bed, containing thousands of plants in a condition ready for planting out, is ravaged to such an extent that every plant is affected. Growers, in the past, by cultivating a large number of seed beds in different parts, especially in the hills, sought to avoid disease in some beds, and usually from these sufficient plants could be obtained for planting-out purposes. A more serious problem has arisen lately in that the disease is not confined to the seed-bed, and quite large areas of planted-out tobacco in various stages of maturity have been ruined by it."

Tobacco-growing is still in its infancy in Western Australia, but already we have experienced one disastrous outbreak of the disease. This was at Manjimup last year on two adjoining properties (6). On both of them the disease was the cause of very poor financial results being returned to the growers. It is with the object of preventing, if possible, similar disasters this year, when hundreds of persons in widely-scattered parts of the State will be planting tobacco for experimental purposes, that the present article is being written.

CHARACTERISTICS OF THE DISEASE.

As shown by Darnell-Smith (4), a tobacco seedling may be infected in the very earliest stages, *i.e.*, when it has not yet developed its first true leaves, but is still in the "cotyledon" or "seed-leaf" condition. From that time onwards, right throughout its life, it may fall a prey to the disease whenever the weather conditions become suitable to the development of the fungus and the plant happens to be in a susceptible condition, provided always that the fungus concerned (*Peronospora sp.*) is present in the correct condition to cause infection. (Many farmers and others appear to have the idea that "downy mildew" ("blue mould") of tobacco can develop spontaneously out of nothing, as soon as the weather conditions become suitable. This is most definitely not so. The "blue mould" disease can only develop if some stage of the "blue mould" fungus (*Peronospora sp.*) is already present in the environment when the weather or atmospheric conditions become suitable. The "blue mould" fungus can only be begotten by the "blue mould" fungus, just as, for example, sheep can only be begotten by sheep, or tobacco plants by previous tobacco plants.)

For an outbreak of the "downy mildew" ("blue mould") disease of tobacco three requirements are absolutely necessary, as follows:—

(i) The correct fungus (*Peronospora sp.*) must be present.

(ii) The weather or atmospheric conditions must be suitable for infection.

(iii) The tobacco plants must be in a susceptible condition.

If any one of these requirements is not satisfied the disease cannot develop. Thus, if the temperature and humidity conditions in the seed-beds were maintained unfavourable to infection, the plants could be bombarded with the *spores* ("seeds") of the causal fungus without the disease developing.

In actual practice "downy mildew" or "blue mould" of tobacco is, in most instances, very largely a seed bed disease, although—as shown above—it may at times cause very severe losses after the seedlings have been planted out. The casual fungus (*Peronospora sp.*) is a member of the rather primitive group of fungi known as the *Peronosporales*, to which also belongs *Phytophtora infestans*, the cause of "Irish Blight" of the potato. All these fungi require abundance of moisture for their best development, and so it is only under the abnormally moist atmospheric conditions of the seed-bed that the disease is likely to be of much consequence in Western Australia. The "downy mildew" of tobacco appears to require very similar conditions to those required by "Irish Blight" for its rapid and serious development, namely, warm, muggy conditions during the day and rather cold air temperatures at night, or fairly rapid alternations of muggy and cold weather. As, therefore, the climatic conditions in the South-Western area of this State are only very occasionally favourable to "Irish Blight," it would seem reasonable to suppose the same would apply to "downy mildew" of tobacco once the seedlings had been planted out. If Western Australian growers can manage to get their seedlings through the seed-bed stage they should experience very little trouble with the disease in the field under normal climatic conditions.

SYMPTOMS SHOWN BY DISEASED PLANTS.

The most characteristic feature of affected plants is the development of a dense, white or greyish down on the *underneath* portions of the diseased leaves. This downy substance is really composed of the fruiting-branches of the fungus loaded with the microscopic lemon-shaped or oval seed-bodies or *spores*. Under the microscope the fruiting structures (*conidiophores*) bear a rather striking resemblance to a dead, but still standing, karri tree, the spores being produced singly

at the extremities of the many-forked branches. Under a strong hand-lens the mildew appears like a mass of densely tangled whitish scrub (Fig. 1b). (The name "blue mould" was given to the disease on account of a very faint *violet* tint occasionally distinguishable in the fungal down, but the name does not seem to me at all appropriate, as, so far as my observation goes, the *least* conspicuous feature of the fungus is its supposed blueness. The name has the further disadvantage of immediately calling to mind the well-known "blue moulds" of fruit and other edible products commonly caused by species of *Penicillium*, to which the *Peronospora* of tobacco has only a distant relationship.)

Looked at from *above*, affected leaves show no evidence of the "downy mildew" itself, but the diseased plants can usually be picked out by the occurrence of irregular yellow blotches on the leaves, or by the drying-out and shrivelling-up of the diseased areas (Fig. 1a). Affected leaves are often a more or less uniform pale yellow in colour when looked at from above. Under conditions very favourable to the fungus the whole plant may soon wither up and completely collapse, but, should unfavourable conditions for the fungus ensue before this occurs, the plant may recover more or less completely until conditions are once again favourable for the further development of the parasite, when the disease may make further headway until perhaps checked yet again by unfavourable conditions. Darnell-Smith (4) records that a plant once infected is always a potential source of infection; "for example, an infected plant kept in an isolated bush house produced a crop of spores in November, another crop in the following March, and a third crop in the following November." On the occurrence of the Manjimup outbreak it was found that infection of the seedlings had almost certainly been brought about by the blowing of *conidia* (spores) from over-wintering diseased plants(6). These old plants on being examined were found in a number of cases to have several dead brown areas on a number of the bottom leaves. On the underneath surfaces of the dead tissues were found large numbers of the typical *Peronospora* conidiophores.

Fig. 1. *a*. (*left*) A young tobacco plant infected with "downy mildew" ("blue mould"). Note the shrivelling of the leaves indicated by the arrows.
b. (*right*). Portion of the underneath side of a young leaf infected with "downy mildew" ("blue mould"). Note the whitish, downy, growth of the fruiting-bodies of the causal fungus, *Peronospora sp.* (Magnified). *After N.S. Wales Dept. of Agriculture.*

In addition to occurring on the cultivated tobacco, "downy mildew" or "blue mould" has been also recorded on a species of native tobacco (*Nicotiana suaveolens*) (1, 4). Darnell-Smith (4) reports that a *Nicotiana* closely related to *N.*

suaveolens obtained from Lord Howe Island was found to be liable to infection. *Solanum pseudo-capsicum* (Jerusalem Cherry) and *Solanum sodomaeum* (Apple of Sodom) gave negative results (4).

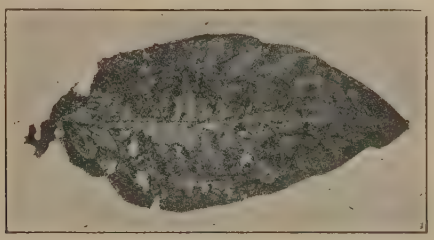


Fig. 2.—Adult tobacco leaf showing holes in places previously attacked by "downy mildew" ("blue mould") due to *Peronospora sp. After N.S. Wales Dept. of Agriculture.*

LIFE HISTORY OF THE FUNGUS.

In spite of the fact that "blue mould" has long been a serious disease in the Eastern States and that numerous short articles on the disease have appeared from time to time in the various Agricultural Journals and elsewhere, there has apparently never been any very intensive laboratory study made of the disease, and so there are many points on which our knowledge is surprisingly meagre.

For instance, it is known that the fungus responsible for the disease may produce thick-walled resting spores in the dead tissues known as *oospores* (1), which may retain their vitality for long periods, but in what numbers they are normally produced or just how important may be their role in nature in carrying the disease over from season to season is unknown.

Another rather surprising feature is that there is very little *exact* data as to the particular climatic conditions under which epidemics of the disease occur. In this connection Darnell-Smith (5) states, "It makes its appearance particularly when the rainfall is excessive" and "a particular relationship must exist between the weather, the plant attacked, and the fungus before the latter can establish itself and spread with rapidity." Just what this relationship is, is not stated. Adam (1) in 1925 wrote, "There is a close connection between climatic conditions and the incidence of 'blue mould' disease. Data in respect of temperature, humidity, and rainfall have been collected at Wahgunyah Experiment Farm and at Buffalo River. . . . . This data, with notes on the disease obtained from year to year, will acquire more interest with the passage of time, but nothing useful can be gained from their presentation here." Mr. Temple A. J. Smith, Tobacco Expert of the Victorian Department of Agriculture, writing on "blue mould" in 1911, stated: "It is worse in or after wet seasons when the first warmth of spring is felt. (Rusty seasons for wheat are generally bad for blue mould.)" (7).

Conidia of the "blue mould" fungus apparently only remain viable for a few days. Adam (1), for example, states, "From its structure the oospore, or resting spore, is able to retain its vitality for quite long periods. In this regard it is distinct from the short-lived conidia, or summer spores, previously mentioned as constituting part of the familiar violet downy patches characteristic of the disease."

In connection with the phenomena of *infection* Darnell-Smith (4) writes—"It has been observed (in numerous infection experiments carried out with the spores of blue mould):—

1. That the spores germinate, under suitable conditions, within twenty-four hours.
2. That they produce a strong germ tube which enters by the leaf pores.
3. That, having entered the leaf, a large number of hyphae are produced in the tissues.
4. That, within eight or nine days, a fresh crop of spores may be produced from the infected leaf.
5. That a tobacco plant in its very youngest stages may become infected with 'blue mould.'"

Angell (3) implies in the following statement that under normal conditions the conidia live, at the most, only a few days, " . . . we have found that . . . under certain conditions of temperature and humidity the detached conidia of the blue mould fungus may remain viable for, and germinate after, 54 hours or more. . . . ."

The same writer further states (3) that in certain experiments "the usual period of seven days required for infection was in this case, as well as in others which have come under our notice, reduced to four days, this being apparently due to the very favourable conditions of temperature (23 deg. C.) (equalling 73.4 deg. F.) and humidity under which the seedlings were kept and more especially perhaps to their extreme susceptibility at that age." "The seedlings used had germinated five to seven days before the experiment was carried out. . . ."

It would seem then that the optimum temperature for infection by the "downy mildew" lies somewhere in the vicinity of 73 deg. F.

On the other hand, in "The Farmers' Handbook," 5th edition, published in 1929 by the New South Wales Department of Agriculture, it is stated, "Experiments conducted by the department during the last few years indicate that if the temperature of the seedlings is not allowed to fall below 45 deg. F. and the surrounding air is not allowed to become humid, blue mould does not make its appearance."

We may conclude then that the conditions favouring the most rapid development and spread of the "downy mildew" or "blue mould" disease of tobacco are warm, muggy conditions during the day with low temperatures at night, or else warm, muggy periods alternating with cold ones. These conditions are similar to those required for epidemics of "Irish blight" in potatoes and various other "downy mildew" diseases of plants.

PRECAUTIONS TO BE TAKEN TO PREVENT THE DEVELOPMENT OF "DOWNY MILDEW" ("BLUE MOULD") OF TOBACCO.

The writer firmly believes that "downy mildew" ("blue mould") of tobacco can be prevented, or at least "controlled," in Western Australia, provided that the proper precautions, as indicated below, are taken.

In this connection no single measure can be relied on for success. Control of such a serious pest as the "blue mould" can only be achieved by the intelligent combination of a series of interdependent practices. These may be stated as follows:—

I. At the conclusion of the harvesting operations for the season, *i.e.*, when all the seed or leaf has been gathered, every tobacco plant on the property should be destroyed, in order to prevent carrying the fungus over from year to year on

over-wintering plants. The best method of destruction would be to pull up the remains of the plants by the roots and burn them, but, if the same field is not to be used again for several years for tobacco-growing, there would be no objection to ploughing the plants under, provided that a mouldboard plough which will completely bury the tissues is used and that any suckers which may happen to grow up are systematically destroyed as soon as noticeable above the ground. Tobacco growers should regard tobacco plants growing on their properties at any other times than when being deliberately grown for seed or leaf as their worst possible enemies, from the point of view of insect and disease dissemination.

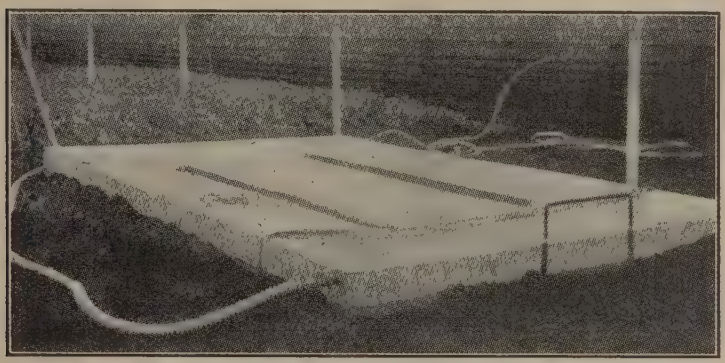


Fig. 3.—Showing a method of sterilising soil by steam, using the "inverted pan" system. Note the flexible steampipe entering the heavy-gauge galvanised iron pan at the front left corner. Note also the handle at the front for lifting the pan from one site to another. The rear handle is hardly obvious in the photograph.—*After Chupp, "Manual of Vegetable Garden Diseases."*

Ministerial approval under the Plant Diseases Act, 1914/25, has been obtained to enable the above operation to be rigorously enforced by the end of June at the very latest. The importance of this step will be realised when it is remembered that the only outbreak in the seed beds we have so far experienced in Western Australia was almost certainly due to infection from diseased suckers found growing near by. (6).

II. The seed beds should be placed in a new position each year, and should be as far as possible removed from curing-barns, or places in which tobacco is stored, or fields which have previously grown tobacco.

III. The seed beds should be *sterilised* in one or other of the following ways:—

(a) by the use of steam at 100 lbs. pressure for half an hour by means of the "inverted pan" system; or

(b) by the use of a strong wood fire on the site of the seed bed for at least four hours. (The heat should be sufficient to cook a 4oz. potato buried three inches deep in the soil, or an egg buried five inches deep.)* Or

* N. A. R. Pollock, "Tobacco Seed Beds," Queensland Agri. Journal," Vol. 34, Part 4, pp. 408-412, October, 1930.

(c) by thoroughly loosening the soil of the seed bed with a spade, etc., and then watering with *formalin solution* made up at the rate of one gallon of commercial formalin to every fifty gallons of water, using half to one and a half gallons of the made-up solution to every square foot of soil. Formalin-moistened bags, or the glass frames or linen covers after being watered with, or dipped in, the formalin solution, should be put on the beds for two days following treatment to hold in the fumes, then removed and the beds stirred and allowed to air for at least 10 days before sowing the seed. When stirring the beds to let out the formalin fumes, after the first two days, or to make a suitable surface on the bed to receive the seed at the completion of the treatment, use a rake or shovel, etc., previously sterilised with steam, fire or formalin.

IV. All seed sown should be soaked before sowing in absolute alcohol for *five* minutes to destroy any infection possibly being carried by the seed.

The Department has undertaken to treat all tobacco seed at a cost of one shilling per ounce or part thereof, and, under the Plant Diseases Act 1914, *the sale or distribution of tobacco seed within the State has been prohibited, unless, and until, the seed has first been disinfected under the supervision of an Inspector under the Act. Under the same Act steps have been taken to have the importation of tobacco seed from other States or Overseas prohibited except for Departmental purposes* (see *Government Gazette* 24th October, 1930). The penalty for disregarding any regulations under the Act is £25.

Disinfection of the seed in absolute alcohol has recently been shown by Angell (2) to be very effective, and this treatment must be considered henceforth a routine practice in tobacco culture. (Departmental experiments have shown that the germination of the seed is not detrimentally affected by as long an immersion as six and one half minutes in absolute alcohol, if the seed is spread out thinly and dried on clean blotting paper, with frequent turning to hasten the evaporation of the alcohol, as quickly as possible following treatment.)

V. Seeing that the "downy mildew" or "blue mould" is greatly encouraged by abundance of moisture, every precaution should be taken to keep the surface of the seed-bed as *dry* as possible after the seeds have germinated. Every effort should be made to reduce the surface waterings to an absolute minimum or even to eliminate them altogether. This may be done by making the soil very firm during the preparation of the seed-bed so that water will readily flow to the roots by capillarity, or by watering, as in the "Marks" system (9), from a trough running along the back of the seed-bed with perforated pipes at right angles carrying the water several inches below the surface of the soil. Another good method of watering is to have agricultural drain tiles placed upright at intervals through the seed-bed, so that the water may be poured down into the sub-surface layers of the bed without directly wetting the surface or the leaves of the seedlings. Seed-beds should have a pronounced slope from the back to the front and should be so built as to lie broadside-on to the morning sun. As soon as the seeds have germinated they could be lightly covered with sterilised white sand, and a little of the sterilised sand could be sprinkled on the bed from time to time as the seedlings grow older. The sand could be sterilised by heating in shallow tins in an oven for several hours, and it could then be stored in sterilised kerosene tins until required.

VI. The glass frames, or the linen or hessian covers to the seed-beds, should be removed every bright, dry, sunny day so as to cause hardening-up of the seedlings and prevent the steamy conditions so favourable to the "downy mildew."

VII. If possible some source of heat should be provided for the seed-beds at night, and during cold days, so as to prevent the temperatures dropping below 45deg. F., as the development of the fruiting-bodies of the fungus (and consequently its rapid spread) seems to be greatly favoured by low temperaures following warm, muggy, conditions just previously. Some growers make use of a fire with a straight-through or return flue *beneath the bed* to keep up the temperatures, while others use a kerosene- or petrol-lamp outside one end of the bed to heat a pipe running through the frames *above* the seedlings. This would seem to be the best type, as tending to lower the humidity of the air above the bed quite considerably, but care must be taken to see that the apparatus cannot get too hot. Moreover, if this method is used, the covers to the seed-beds must be erected considerably further above the surface of the beds than is common practice at the present time.

In "The Farmers' Handbook," 5th edition, published in 1929 by the New South Wales Department of Agriculture, it is stated: "**Experiments conducted by the department during the last few years indicate that if the temperature of the seedlings is not allowed to fall below 45deg. F. and the surrounding air is not allowed to become humid, blue mould does not make its appearance**" (8).

VIII. Seed-beds should be made long and narrow, and not short and broad. About a yard wide should be ample. This type of construction greatly facilitates the work of weeding, transplanting, etc., and there is not nearly so much chance of spreading infection mechanically during inspection of the seedlings.

IX. Seedlings should be lightly dusted every seven days or so, particularly on the *underneath* sides of the leaves, with a recognised copper carbonate-sulphur dust such as "Azurine No. 4," or a copper-lime dust such as "Bordo No. 2." This can be fairly readily applied by the use of a "sulphur bellows" provided with a straight nozzle. The bellows should be held several inches above the seed-bed at the handles and pointed forward and slightly down, so that a cloud of dust will hit the earth at a very acute angle and in glancing off and rising will come in contact with the bottom sides of the leaves. Moderation must be used in the application of the dust, and care must be taken to remove the frames whenever the sunlight becomes very hot following the treatment, or considerable "sulphur scorching" of the foliage may result from any dust containing sulphur.

X. Seed-beds should be planted as *late* as possible in the spring, as the lower the atmospheric humidity during the growth of the seedlings and following transplanting the less is the danger of loss from "downy mildew." Considerably more seedlings should be raised than are actually required for planting out, and a succession of sowings in different seed-beds at weekly or fortnightly intervals may be of considerable value in ensuring that some at least will come through to planting-out time unscathed.

XI. If possible, tobacco should not be grown more frequently than, say, once in three years on the same paddocks, as the fungus, in the resting-spore (*oospore*) stage, can apparently remain alive in the soil for a long period.

XII. In the event of "downy mildew" breaking out in the field, the plants should be sprayed with Bordeaux Mixture 3-3-50 plus ½lb. calcium caseinate to every 50 gallons of spray, taking great care to see that the bottom sides of the leaves are thoroughly sprayed. (Preparation of Bordeaux Mixture is fully described in Leaflet No. 314, available, free of charge, on application.) Instead of spraying, the plants could be dusted with a recognised copper carbonate-sulphur or copper sulphate-lime dust, although after planting-out spraying will be found more effective than dusting.

XIII. Should any plants in the seed-beds become affected with "downy mildew," they, and the immediately-surrounding plants, should be destroyed *before*

removing from the bed by watering with a little strong bluestone solution made up at the rate of 1 lb. to 1 gallon of water. After the plants are dead, or thoroughly wet with the bluestone on the bottom sides of the leaves, they should be removed and burned, or deeply buried.

XIV. All precautions should be taken to keep down insect pests, as these are very liable to carry infection into the bed from neighbouring farms or from plant to plant in the beds. Angell (3) has recently shown that the "potato moth" or "tobacco leaf miner" (*Phthorimaea operculella*, Zell.) can readily carry infection, and the same undoubtedly applies to other insects such as the Lucerne Flea (*Smynthurus viridis*, Linn.) or the Red-legged Earth Mite (*Penthaleus destructor*, Jack.), etc.

A space free of all vegetation should be left for several yards around the tobacco beds as this will act as a good break to the lucerne flea, mite, and other similar walking or hopping insects.

XV. Growers should refrain from visiting other growers' seed-beds, as one careless human might carry considerably greater numbers of fungus seeds (*spores*), and for much greater distances, than many insects.

XVI. All "native tobacco" plants (*Nicotiana suaveolens*) or other wild tobacco species on a tobacco plantation, or in a tobacco-growing district, should be periodically destroyed, as they may harbour the "blue mould" fungus. *Nicotiana suaveolens* has definitely been proved liable to infection (1, 4) and, as stated above, Darnell-Smith (4) reports that a *Nicotiana* closely related to *N. suaveolens* obtained from Lord Howe Island was found to be liable to infection.

XVII. Care should be taken to avoid dropping cigarette-ends or fragments of cut leaf from commercial smoking mixtures, especially if air-cured, on the seed-beds of tobacco fields, as it is possible that infection may occasionally be carried in that way.

FINAL WORD.

All the above may seem a lot of trouble to go to, but there is no doubt that the successful Australian tobacco-grower of the future will be he who never tires of going to what other people would call trouble, to ensure successful results. The rewards for successful tobacco culture in Australia are very great, but nature certainly seems to be doing her best to ensure that the rewards shall not be too easily won. Biological laws are no less immutable, or less certain in their outcome, however, than physical ones, and he who correctly sets the stage in every detail must inevitably reap the reward.

LITERATURE CITED.

(1) Adam, D. B.—"The Blue Mould (*Peronospora*) Disease of Tobacco."—Journal Dept. Agric., Victoria, Vol. 23, pp. 436-40, 1925.

(2) Angell, H. R.—"Blue Mould of Tobacco: Investigations concerning seed transmission."—Journal C.S.I.R., Australia, Vol. 2, pp. 150-160, 1929.

(3) Angell, H. R.—"Blue Mould of Tobacco: Progress Report on an Insect Vector."—Journal C.S.I.R., Australia, Vol. 3, pp. 83-86, 1930.

(4) Darnell-Smith, G. P.—"Infection Experiments with Spores of Blue Mould Disease of Tobacco."—Agric. Gaz., New South Wales, Vol. 40, pp. 407-8, 1929.

(5) Darnell-Smith, G. P.—"Diseases of Tobacco Plants: Blue Mould and a Bacterial Disease."—Agri. Gaz., New South Wales, Vol. 29, pp. 82-88, 1918.

(6) Pittman, H. A.—"An Outbreak of 'Downy Mildew' (so-called 'Blue Mould') of Tobacco in Western Australia."—Journ. Dept. Agric., W.A., Vol. 7 (2nd series), pp. 469-476, 1930.

(7) Smith, Temple A. J.—"Tobacco Culture," Bull. No. 8 (New Series), Dept. Agric., Victoria, 1910-11.

(8) "Fungous Diseases of Tobacco: Blue Mould," *in* "The Farmers' Handbook." Dept. Agric., New South Wales, 5th Edition, pp. 604-5—Government Printer, Sydney, 1929.

(9) "Report from Select Committee on the Tobacco-growing Industry in Australia."—Government Printer, Canberra, F.C.T., 1930.

THE NATURAL PASTURES OF WESTERN AUSTRALIA.

C. A. Gardner, Government Botanist.

INTRODUCTION.

The term "Pasture" is one which appears to have no strict definition. The nature of pastures and their composition varies in different countries, and even in districts within a quite small area. As usually understood, pastures are associations of vegetation which are used for grazing animals, in which associations herbage plays a prominent part, and amongst the herbage edible plants, especially grasses, are predominant.

In Australia, pasture has a still wider meaning, and includes country in which grass is present in any quantity, country in which both herbage and edible tree-growths occur, and country which carries little or no grass but in which the shrubs themselves constitute the forage. Such are the natural pastures of Australia, in which the farmer or stock owner has done nothing to create, and which he does but little to maintain. The improvement and management of these is largely a question of the regulation of the carrying capacity, the principal danger being one of injudicious stocking.

Artificial pastures, on the other hand, are pastures laid down by man, suitable plants being laid down and maintained for the purpose of providing forage for stock. They are temporary or permanent according to the climatic or soil conditions, the nature of the constituent plants, or the requirements of the owner.

Pastures are therefore (a) natural or artificial, and (b) permanent or temporary. They are primarily governed by the factors of climate and soil, the former being the more important.

Western Australia may be divided into three climatic zones: (i) a northern tropical area which experiences reliable periodic rains which fall in the summer, the cooler season being dry; (ii) a southern temperate area of definite winter rainfall alternating with a dry summer; and (iii) an intermediate zone which is essentially a region of summer rainfall, but in which the precipitations are highly intermittent and altogether unreliable. Each zone is again capable of climatic division, but this subdivision most closely affects artificial pastures, and will be dealt with subsequently.

Permanent natural pastures are confined to the northern area where summer rains prevail. These pastures are essentially Grasslands, and assume three forms according to climatic or soil types. We may thus recognise typical Grasslands in the Kimberleys on the black soil plains where the rich alluvium brought down by the rivers, and the warm climate produce extensive tracts of tussocky and other grasses in close formation to the exclusion of all else except such other herbaceous growth as is able to successfully compete with them. The richer basaltic flats furnish another example of the same formation. Then there is the *Steppe* formation, consisting of harsher grasses which are necessitated by the drier nature of the soil or extreme climatic conditions. Steppes are found in their typical form in Russia and in the Prairies of America, and in both cases continental climates prevail. Their counterpart in Australia is found in the tussocky country of the Pilbarra District and the drier regions of Kimberley, and in a still more extreme form in the Spinifex country of the arid interior. The third type is known as *Savannah*. This is grassland carrying scattered trees.

The intermediate zone, with its unreliable rainfall, carries Spinifex country, alkali flats with clay pans and the so-called "salt lakes," and a peculiar type of savannah known as "Mulga Bush." The term "Mulga" embraces a number of species of Acacia characterised by stiff greyish "leaves" and usually an umbrella-like habit of growth, and large areas are given over almost exclusively to the Mulga bushes with their herbaceous undergrowth and small scattered shrubs amongst which saltbushes are not uncommon. Indeed, so typical is Mulga of the area in question, that it may be referred to as the "Mulga zone." The constituents of the undergrowth vary considerably, temporary (annual) grasses and other herbaceous forage plants occurring in varying quantities, mixed with some tussocky grasses including Spinifex, and edible shrubs. The main herbaceous forage, however, consists of the annual ephemeral plants whose existence is absolutely dependent upon sufficient seasonal rains to ensure their life cycle. When such precipitations fail over two or more seasons the Mulga becomes of importance, providing much of the available forage, and for this reason the Mulga is of outstanding importance in the economy of the Mulga zone.

Further to the south, below the limit of summer rainfall, the Eucalyptus country is encountered. Here grassland as a formation fails. This is because the conditions favourable to grassland do not exist. The wet season synchronises with the cold period of the year. This is zone iii—the area of definite winter rainfall. The warm spring rains bring forth an ephemeral growth of grass which disappears with the advent of the hot dry weather. These grasses are usually low in forage value, the exceptions being those species which occur in depressions or other spots which retain some moisture until later on in the season. Grassland cannot occur where high temperatures synchronise with the dry period in countries which have marked wet and dry seasons. Thus the winter rainfall area of Western Australia is remarkably poor in its grass flora, and such grasses as are perennial are either inhabitants of moist locations, or are of a harsh nature and low palatability.

Summarised briefly, therefore, grassland occurs naturally in that portion of the State which receives rain during the summer, and, owing to the reliability of these precipitations in the far north, true grassland exists, whereas in the middle zone, owing to the highly intermittent nature of the rainfall, the only permanent grasses are those characteristic of Steppes, but the appearance of the country is wonderfully changed by the rich ephemeral growth which follows good seasonal rains.

It must furthermore be understood that the limits of seasonal distribution of the rainfall do not follow exact lines. In general it may be said that the Mulga zone is outside the influence of effective winter rainfall, but the limits of summer rainfall are by no means so definite. The tropical monsoonal weather is sometimes accompanied by low-pressure systems which develop off the Pilbarra coast and, as small centres of intense activity, sweep inland in the south-easterly direction, bringing heavy rain. These "Willy Willy" disturbances are, in the main, responsible for the rainfall of the intermediate zone, and although they are as a rule only effective within this zone, they may occasionally become more general and afford bounteous rains to the drier parts of the South-West zone. Thus the country known as the Eastern Goldfields often benefits by these summer visitations, and with the incidence of warm weather, a remarkable growth of native grasses may result. This applies particularly to burnt country, or forest country where the undergrowth is sparse, so that root competition does not hinder to any great extent the development of the grass growth. These perennial grasses do not persist as perennials, but usually die out after the first or second year.

In the South-West the natural pastures are very poor in constitution. Indeed they scarcely justify the term. A few areas, such as the Jam country, or the Tuart country of the west coast, carry a scant growth of annual grass which is eaten in the dried state in the summer in addition to providing spring feed, but except for artificial pastures the capacity of the area would be negligible. The pastures that have been established result from the following:—

(a) *Clearing and grazing only.* Clearing, and the advent of stock, are responsible for the entry of exotic plants.

(b) *Clearing and cultivation*, including the use of superphosphate. This, with stocking, results in the diminution of native plants and the increase of exotic annuals. Superphosphate tends to increase the leguminous constituents.

(c) *The sowing of annual pasture plants*, together with *top-dressing*. Annual artificial pastures.

(d) *The sowing of perennial pasture plants.* Permanent artificial pasture. This is only possible in soil which is moist during the summer. This soil may be naturally moist, or irrigated.

(e) *Swamp pastures.* Land inundated in winter, and available to stock in summer only.

THE CENTRIFUGAL CREAM SEPARATOR.

G. K. BARON-HAY.
Superintendent of Dairying.

The cream separator is undoubtedly the most essential machine found on dairy farms to-day. Without it the concentration of cream (butter fat) at central factories for the economic manufacture of butter would be almost impossible in this State where dairy farms are scattered, and on its efficiency depends to a great extent the proper utilisation of milk produced on farms. In spite of this, however, one frequently finds this piece of machinery sadly abused. A knowledge, therefore, of the principles on which the cream separator is constructed is of first importance.

In the separation of cream the force utilised is centrifugal force, and in the sense here used, is understood to be that force which causes a body revolving rapidly around a central point, to fly from that centre.

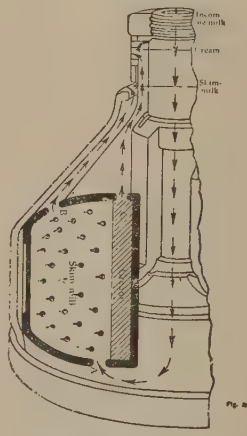
The separation of cream from milk in the centrifugal separator is based on the well known physical law that, when liquids of different specific gravity are rapidly revolved around a common centre, a greater force is exerted on the heavier liquid than on the lighter, causing the heavy liquid to "fly off" or separate furthest away from the centre. Milk consists of two liquids of different specific gravities—the fat particles and the milk serum, and by a suitable mechanism, therefore, may be separated into these two liquids by the utilisation of this force. This principle has been known for centuries and is said to have been utilised by the Chinese for the separation of fruit juices by the simple process of filling gourds with the juices they wish to separate and swinging them rapidly in a circular motion until separation was accomplished. It was not, however, until 1878, that the first continuously operated centrifugal separator was manufactured by Dr. DeLaval for the separation of cream from milk.

Courtesy Alfa-Laval Separator Co. Ltd.

One is familiar with the reasons for the rise of cream to the surface of milk in the gravity setting process, and the same rules may apply to centrifugal separation. The basis of both processes is that the butter fat globules are lighter than the skim milk or serum and rises to the surface of the milk upon standing. Owing to the immense force which may be exerted centrifugally, the separator carries out in seconds what gravity setting cannot carry out in hours. This is illustrated graphically in figures 1 to 4, made available through the courtesy of the Alfa-Laval Separator Co., Ltd.

Illustration No. 1 shows an ordinary cup in which gravity separation is taking place. A layer of cream is shown at the top, and dots are used to show the rising fat globules.

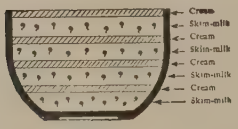
In Illustration No. 2 the cup of milk is placed on one side of a cream separator bowl. By revolving the bowl at approximately 6,000 revolutions per minute, the cream and skim milk, through the centrifugal force exerted, behave as in Fig. 1, the cream passing to the centre of the bowl while the skim milk, being heavier, is forced to the outside. By boring three holes through the wall of the cup as shown in Fig. 2, the bowl is converted into a crude continuously operated separator. Incoming milk enters the cup at "A," the opening being placed a little below and to the left of the cream line. An opening "B" in the bottom of the cup allows for the escape of skim milk, and finally an opening "C" in the cream layer allows for the cream discharge.



Courtesy Alfa-Laval Separator Co. Ltd.

The capacity of such a separator would be limited, its skimming efficiency low, and there would be no means of regulating the thickness of the cream.

It is known that globules of butter fat rise in milk at a speed depending upon the size of the globules and the temperature of the milk. Assuming that this speed is 1in. in four hours, and that the cup in Illustration 3 is 4ins. deep, 16 hours will be required for gravity separation to take place, which, however, is never complete, the skim milk containing from ·5 to ·6 per cent. of butter fat.

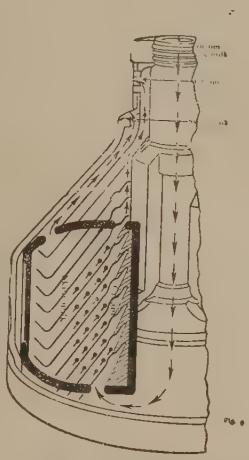


Courtesy Alfa-Laval Separator Co. Ltd.

Suppose that partitions are placed in the cup so that the milk is divided into four layers each 1in. thick (*See* Fig. 3), the fat globules will then have to rise a maximum distance of 1in. instead of 4ins., and the setting period therefore will be but one-fourth as long as previously. If these partitions are slanted so that they will lead the layers of cream to the top of the cup, the capacity will have been greatly increased as compared with the simple arrangement in Illustration No. 2, as the partitions or discs lessen the period of time required for the centrifugal force to separate the fat globules from the skim milk. In practice the discs divide the milk into very thin

layers, varying in different makes of separators, but of only several thousandths of an inch in thickness. These discs also enable the whole of the milk to be revolved immediately it enters the bowl.

If a bucket of water is held by the handle, it is possible to rapidly rotate the bucket whilst only the water close to the edge of the bucket will rotate immediately, considerable spinning being required before the water is revolving at the same speed as the bucket. If, however, the water was in very thin layers in the bucket, friction would be sufficiently strong to rotate all the water immediately.



Courtesy Alfa-Laval Separator Co. Ltd.

Although placing discs in a separator bowl greatly increases its capacity and efficiency, the actual degree of centrifugal force developed in the bowl depends entirely on the diameter of the bowl and the speed at which it is rotated. As centrifugal force is greatest at the outer edge of the bowl, the thickness of the cream which the machine delivers may be regulated by arranging the cream outlet so that it can be moved to take cream from almost the exact centre of the bowl. All separators have an adjustable screw so arranged that cream may be drawn at different distances from the centre of the bowl, a very slight variation in distance from the centre causing a great difference in the fat content of the cream delivered.

From the foregoing it will be apparent that the cream separator is a delicate piece of apparatus, and in order to maintain its mechanical efficiency should be treated exactly as the various makers prescribe in the booklet always supplied with the machine.

Conditions affecting the Skimming efficiency of the Separator.

Modern separators have a skimming efficiency as high as 98 per cent. of the fat of the milk, and should leave in the skim milk not more than ·1 per cent. of fat under normal conditions.

The chief factors which control the skimming efficiency of the cream separator are—speed of machine, rate of milk inflow, temperature of the milk, evenness of running, and cleanliness of separator.

Farmers are advised to test the efficiency of their machine, from time to time, by forwarding a sample of the skim milk to the factory for testing purposes. This is especially important where a large number of cows are being milked.

1. *Speed of Separator.*—The higher the speed the greater is the centrifugal force, and therefore the more complete is the separation. Each machine should be operated at the speed recommended by the makers, as, if the speed is reduced below that required, the skimming efficiency will be lessened. A greater speed than that recommended, however, may not give increased economical separation, and causes undue wear and tear of the machine. The operator, therefore, should time himself by counting the turns of the crank per minute, and by doing this occasionally will soon learn the necessary rapidity of motion required to run the machine at full speed.

The following table shows the loss of fat in skim milk due to operating the separator at too low a speed, given by Hunziker :—

Skim Milk and Cream.	Speed of Separator. 10–15 R.P.M. above normal percentage fat.	Normal percentage fat.	10–15 R.P.M. below normal percentage fat.	20–30 R.P.M. below normal percentage fat.
Skim Milk	·029	·029	·120	·210
Cream	32·00	28·50	26·00	23·00

2. *Rate of Inflow.*—The rate of inflow is regulated by means of the float in most hand-separators, the float being contained in a small bowl, and by floating on the milk as the bowl is filled, presses against the tap, preventing a full flow of milk. This rate has a very marked influence on the efficiency of separation. If the rate is increased beyond the capacity of the separator, the skimming efficiency decreases, as the milk passes through the bowl too rapidly to allow the centrifugal force to complete separation. A slower rate of inflow, although not affecting efficiency, is of no advantage. A number of experiments carried out by the Purdu Agricultural Experiment Station illustrate this :—

	Large inflow.		Normal inflow.		Small inflow.	
	Per cent. of fat.		Per cent. of fat.		Per cent. of fat.	
	Cream.	Skim milk.	Cream.	Skim Milk.	Cream.	Skim milk.
Average of six experiments	23	·145	29	·028	30	·027

Care, therefore, should always be taken to see that the float is not damaged.

3. *Effective temperature of Milk.*—Efficient skimming is best carried out when the milk is separated at approximately the temperature at which it leaves the animal body, *i.e.*, 95 to 100° Fah. At this temperature the butter fat is still in the liquid form and in a condition for easy separation. Where milk has cooled to 70° Fah. or lower, *i.e.*, feels cold, there is a distinct loss of fat in the skim milk on separation. When milk so cooled is subsequently warmed to 85 to 90° Fah., the fat globules are still largely in a solid state, and the skimming efficiency remains low. In order to bring this back to normal, the milk must be heated above the temperature of the melting point of butter fat, *i.e.*, about 100° Fah., and held there sufficiently long to permit the fat to melt.

4. *Smoothness of Running.*—Not infrequently separators are noticed screwed to tables or other objects not firmly embedded in the floor, causing vibration when the separator is turned. The trembling of the machine may cause portion of the cream and skim milk to again become mixed, causing a relatively large amount of butter fat to be lost with the skim milk. The following table gives the average results from a number of trials carried out with trembling and smoothly running machines :—

	Balanced.	Unbalanced.
	Skim milk. Per cent. fat.	Skim Milk. Per cent. fat.
Average (6 experiments) ...	·03	·17

It will be noticed that in unbalanced or unsecured separators the loss of butter fat may be increased as high as six times above the normal.

5. *Cleanliness of Machine.* -However carefully milking may be carried out by the operator, the milk will be found to contain a certain percentage of impurities such as dirt, dust, etc., which has gained access during its production. This foreign matter, together with a portion of the albumen present in milk, collects in the separator bowl, forming the so-called separator slime. This is deposited largely on the walls of the bowl and between the internal contrivances. It has been found that the fat lost in the skim milk by the use of unclean separators was approximately three times as great as when using a clean separator bowl. This provides an additional reason- besides the all-important one of producing clean cream -for the washing of separators after each separation.

REPORT OF SHEEP-FEEDING EXPERIMENT CARRIED OUT AT MURESK AGRICULTURAL COLLEGE.

J. H. RICHES, B.Sc. (Ag.).

[Being a thesis accepted as partial fulfilment of the requirements of the Degree Bachelor of Science in Agriculture with Honours in the University of Western Australia.]

Introduction.—Since the beginning of the twentieth century many investigations have been carried out all over the world in connection with Animal Nutrition.

These include investigations into the nutritive value of foods, disorders arising from faulty nutrition and many other problems.

In Western Australia there is probably no problem in connection with stock of more importance than that concerned with handfeeding during the dry period of the year.

In the South-Western part of Western Australia the climate is of the Mediterranean type and there is practically no summer rain. The months of November to March are typically dry, and pastures are frequently dormant, or scanty, from about the end of November until the following May.

It is therefore necessary, wherever the land is fully stocked, to supplement the dry herbage with some additional fodder through the latter part of summer and the beginning of winter until the new feed has made some growth.

Little experimental work has been done to discover the most suitable kind of feed to provide this supplement. The problem seems important, as without some handfeeding it is doubtful whether most farms can be kept fully stocked all the year round. The experiment reported in this paper was designed to obtain some reliable information on the subject.

Method.—As in the greater part of the agricultural districts sheep are the class of stock usually grazed, these animals were chosen for the experiment. The flock available consisted of two-tooth Merino ewes which were dropped in May, 1928; they were a very even lot as regards type. From these, one hundred of the best were selected for the experiment. The sheep selected were then divided into five lots of twenty sheep each, the lots being made as even in aggregate live weight and in type as it was possible to judge.

Unfortunately, although rams had never been put with the selected ewes, it became evident later that a few had been accidentally mated, as these gave birth to lambs during the course of the experiment.

The number of ewes which lambed is stated in Table I. Their live-weights were excluded from the final results, thus reducing somewhat the numbers of

sheep in the various lots, but their presence involved no other disabilities. In view of their small number it is considered that the omission of these sheep does not seriously affect the results.

TABLE I.

Number of Ewes lambing and effective number in each lot.

Lot No.	Ewes Lambing.	Effective No.
1	2	18
2	1	19
3	3	17
4	3	17
5	4	16

For the purpose of the experiment each of the sheep carried a numbered ear tag. They were weighed individually, the weight of each sheep being recorded against its respective number. Weighing was conducted to the nearest half-pound in a crate specially built for this purpose. The operation was carried out at the same time of day on each occasion. As far as possible it was conducted at intervals of one week; on several occasions, however, the length of the intervals was altered owing to the fact that there had been rain, and in consequence the sheep were wet.

The site selected for the experiment was five acres of gently rising ground close to the college; this land was subdivided into five small paddocks of one acre each. One of these paddocks was used for each lot of sheep. The paddocks were entirely clear of vegetation except for a few trees along the fence bounding them on the North-West side; these consisted of Jams (Acacia acuminata), and were large enough to provide sufficient shade for every paddock.

The experiment was commenced on 24th March and was continued for a period of just over fourteen weeks until 2nd July, when feed was once more becoming abundant.

Rations.—As the original idea of the experiment was to determine the best supplements for natural pasture the ideal base of the ration would have been pasture. This, however, was impossible of achievement. As wheaten stubble, however, forms a considerable proportion of the ordinary summer pasture of the agricultural districts, an endeavour was made to simulate stubble conditions by providing wheaten straw, in practically unlimited quantities, as a basal ration.

In selecting the supplementary fodders, it seemed better to avoid purchased materials at this stage and use only such as can be produced on the farm. The different feeds tested were wheaten chaff, silage, oats, and mixtures of chaff with oats and of silage with oats.

The rations fed, in lbs. per head per day, are given in Table II.

TABLE II.

Experimental Rations Fed.

Lot No.	Chaff.	Silage.	Oats.
	lbs. per head.	lbs. per head.	lbs. per head.
1	1	...	...
2	...	3	...
3	...	...	½
4	½	...	¼
5	...	1½	¼

The basal ration, straw, was scattered on the ground in liberal quantities twice weekly; the supplementary rations (Table II.) were fed daily at 8 a.m. in shallow troughs in the centre of the pens, the troughs being sufficiently large to accommodate with ease all the sheep in each pen at one and the same time. No difficulty was experienced in getting the sheep accustomed to feeding out of the troughs.

The chaff, silage, and oats used were all produced on the College farm.

The chaff was made from wheaten hay cut in 1929 and was of fair quality. It was at times, however, somewhat dusty and was rather badly infested with grain moth.

The silage was made from an oaten crop in 1929 and was a good sample of acid brown silage, light yellow-brown in colour.

The oats were Algerian feed oats of fair average quality.

In Table III. are given the analyses of the three feeds as determined from representative samples by the Government Analyst.

Table III.

Analyses of Feeds.

	Chaff.	Oats.	Silage.
Moisture	12·00	6·00	64·00
Ash	4·84	3·91	2·18
Crude protein	2·91	9·58	1·67
Ether extract	2·36	8·18	·91
Fibre	27·68	11·03	10·78
N free extractives ...	50·21	61·30	20·46
	100·00	100·00	100·00

On two occasions in the course of the experiment the quantities of the feed supplied were altered, viz., on 7th April the ration for Lot 1 was reduced to ¾ lb. chaff per head and that for Lot 2 to 2 lbs. silage per head, as this was approximately all that these lots would consume; again on 12th May, on account of cooler weather, it was thought necessary to increase the amount of feed of all lots. As, however, Lot 1 were still not consuming all their ration, their ration was left unchanged. The increases in the rations of the other lots were as follows:—

Lot 2 increased to 2½ lbs. silage.

Lot 3 increased to ¾ lb. oats.

Lot 4 and Lot 5 increased by ⅛ lb. oats each.

Records of all rejected feed were kept throughout, but appreciable amounts were left by Lots 1 and 2 only.

Results.—The average weights of the sheep in each of the five lots at the beginning of the experiment were reasonably close to one another, there being less than 2 lbs. difference between the heaviest and the lightest. These average

weights, together with the average weights at each successive weighing, are given in Table IV.

TABLE IV.

AVERAGE WEIGHT OF SHEEP IN EACH LOT AT SUCCESSIVE WEIGHINGS.

Lot No.	24-3-30	31-3-30	7-4-30	14-4-30	23-4-30	28-4-30	6-5-30
1	72·61	73·75	73·61	72·31	67·47	67·97	67·64
2	73·05	76·53	73·92	72·71	69·66	70·76	70·50
3	71·53	72·18	72·09	72·50	69·09	70·82	69·71
4	73·47	74·97	74·24	74·09	71·29	72·29	71·50
5	71·72	73·34	72·75	73·06	70·53	70·38	70·28

Lot No.	12-5-30	19-5-30	26-5-30	2-6-30	9-6-30	16-6-30	2-7-30
1	66·17	65·08	66·19	65·86	65·25	62·00	60·22
2	69·84	68·71	68·21	66·76	65·18	61·79	61·03
3	70·97	70·76	71·59	71·38	69·32	68·44	68·12
4	71·91	70·29	70·68	69·85	69·35	69·15	66·79
5	70·25	69·81	71·37	70·56	70·13	69·69	68·47

In Table V. are shown the variations from the initial average in the average weight of each lot at successive weighings, while in Table VI. these variations are shown as percentages of the average weight at the beginning of the experiment.

TABLE V.

VARIATIONS FROM INITIAL AVERAGE WEIGHTS.

Lot No.	31-3-30	7-4-30	14-4-30	23-4-30	28-4-30	6-5-30
1	+1·14	+1·00	—0·31	—5·14	—4·64	—4·97
2	+3·47	+0·86	—0·35	—3·40	—2·29	—2·55
3	+0·65	+0·56	+0·97	—2·44	—0·70	—1·82
4	+1·50	+0·77	+0·62	—2·17	—1·17	—1·96
5	+1·63	+1·04	+1·35	—1·18	—1·34	—1·43

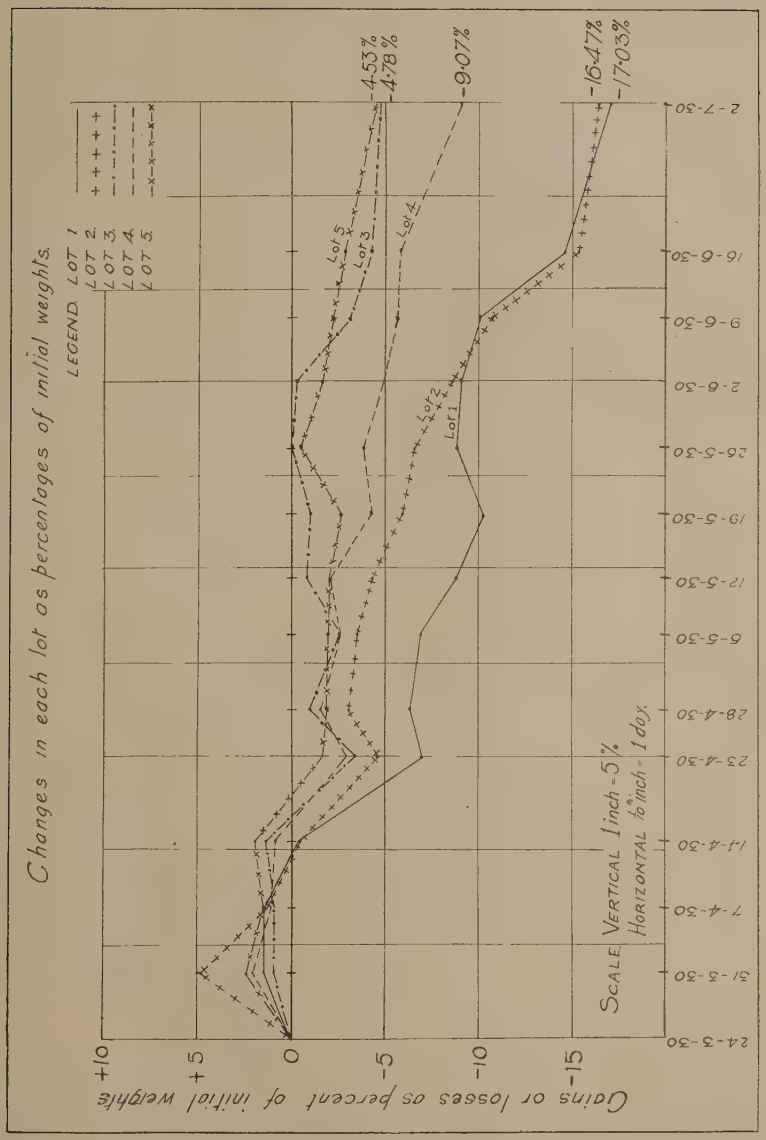
Lot No.	12-5-30	19-5-30	26-5-30	2-6-30	9-6-30	16-6-30	2-7-30
1	—6·44	—7·52	—6·41	—6·74	—7·35	—10·60	—12·38
2	—3·21	—4·34	—4·84	—6·29	—7·87	—11·26	—12·02
3	—0·56	—0·77	+0·05	—0·16	—2·22	—3·10	—3·42
4	—1·55	—3·17	—2·79	—3·61	—4·11	—4·32	—6·67
5	—1·46	—1·90	—0·34	—1·15	—1·59	—2·03	—3·25

TABLE VI.

PERCENTAGE VARIATIONS FROM INITIAL AVERAGE WEIGHTS.

Lot No.	31-3-30	7-4-30	14-4-30	23-4-30	28-4-30	6-5-30
1	+1·57	+1·38	—0·43	—7·07	—6·38	—6·84
2	+4·75	+1·18	—0·48	—4·66	—3·14	—3·49
3	+0·91	+0·78	+1·36	—3·41	—0·98	—2·54
4	+2·04	+1·05	+0·84	—2·95	—1·59	—2·67
5	+2·27	+1·45	+1·88	—1·64	—1·87	—1·99

Lot No.	12-5-30	19-5-30	26-5-30	2-6-30	9-6-30	16-6-30	2-7-30
1	—8·86	—10·34	—8·83	—9·28	—10·12	—14·60	—17·03
2	—4·39	—5·94	—6·62	—8·61	—10·78	—15·40	—16·47
3	—0·78	—1·08	+0·07	—0·22	—3·11	—4·34	—4·78
4	—2·11	—4·31	—3·79	—4·91	—5·59	—5·87	—9·07
5	—2·04	—2·65	—0·47	—1·60	—2 22	—2·83	—4 53


Changes in each lot as percentages of initial weights.
LEGEND LOT 1
LOT 2.
LOT 3.
LOT 4
LOT 5
-4.53%
-4.78%
-9.07%
-16.47%
-17.03%
Lot 5
Lot 3
Lot 4
Lot 2
Lot 1
Gains or losses as percent of initial weights
+10
+5
0
-5
-10
-15
SCALE VERTICAL 1 inch = 5%
HORIZONTAL 16 inch = 1 day.
2-7-30
16-6-30
9-6-30
2-6-30
26-5-30
19-5-30
12-5-30
6-5-30
28-4-30
23-4-30
14-4-30
7-4-30
31-3-30
24-3-30

In Figure I. the data of Table VI. are given in graphical form.

An inspection of these figures and the graph at once draws attention to a number of points, viz.:—

1. There was a decided increase in all lots during the first week, followed by a fall in the second week. The increase may, possibly, be due to the restriction of exercise, the gain not being maintained as the sheep became accustomed to the conditions.

2. All lots show a pronounced loss between 14th and 23rd April. This coincides with a period in which .45 inches of rain and some very low maximum and minimum temperatures were recorded, and can almost certainly be ascribed to these conditions.

3. There is no very marked effect to be ascribed to the increase in the rations on 12th May, but possibly the increase in weight between 19th and 26th May in Lots 3, 4, and 5 can be credited to this cause.

4. The lines appear to fall into three distinct groups:—
   (a) the coarse fodders, chaff and silage, which appear to be definitely inferior as supplements;
   (b) the mixture of chaff and oats which, although considerably superior to chaff or silage alone, is still inferior to the other two supplements tried;
   (c) oats alone and oats with silage, which appear to be about equal in value and considerably better than the other three.

A study of the analyses of the various foods suggests a probable explanation of this grouping.

The analyses, although not identical, agree fairly closely with those given by Kellner (1) and Wood (2) for the same class of foods, it seems reasonable therefore, to assume that the percentage digestibility of the nutrients in the various foods will be of the same order also. Working on this assumption, the starch equivalent and nutritive ratio of each of the supplementary rations per head per day was calculated. These figures are given in Table VII.

TABLE VII.*

Starch equivalents and nutritive ratios.

—	Chaff.	Silage.		Oats.		Chaff and Oats.		Silage and Oats.	
		1st ration.	2nd ration.	1st ration.	2nd ration.	1st ration.	2nd ration.	1st ration.	2nd ration.
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
S.E. ...	·41	·30	·37	·35	·53	·45	·54	·40	·49
N.R. ...	23·9	19·9	19·9	8·8	8·8	14·4	13·0	13·7	12·4

It is obvious at once that while the difference in energy value of the five rations is fairly considerable, there is no clear connection with the changes in live weight. When the nutritive ratios are studied, however, even greater variation is noted, but it is at once apparent that the two foods which were found

* First ration 7th April to 12th May. Second ration 12th May to end.

least satisfactory are those with nutritive ratios admittedly too wide for general feeding and especially for sheep, whose wool is highly nitrogenous. The two mixed rations are also somewhat wide but conform more to recognised standards, while oats show a ratio of medium width.

The straw which formed the basal ration would probably provide the necessary extra starch equivalent but would certainly be still lower than chaff in protein content, and hence unable to correct the width of the ratios. It appears probable that deficiency of protein was a main cause of the poorer results from the first two rations.

Oats alone (ration 3) was the most favourable in nutritive ratio, but it did not, however, excel ration 5 probably because along with wheaten straw it was too little laxative.

There is no explanation from the figures (Table VII.) of the different results from rations 4 and 5, and the superiority of ration 5 is almost certainly due to its more laxative character. The results indicate that on dry pasture, silage included in a mixed feed of suitable nutritive ratio has an important dietetic effect.

In farm practice any one of the three rations: oats, oats + chaff, or oats + silage, would be found satisfactory, but in varying measures. The decision as to which one should be adopted in any particular case would depend on individual circumstances. Where the grazing includes a green bite, *e.g.*, weeds in stubble, oats alone would probably be found entirely satisfactory; where there is nothing but dry stubble the inclusion of silage with oats is economical and useful. Good chaff, especially when harvested early, has undoubted uses either alone or in mixtures. A controlling factor in any instance will be the ruling prices for oats and chaff and the facilities for ensiling green fodder.

Costs.—Another important angle from which the various rations must be viewed is that of actual cost of production.

It was impossible to work out actual costs for the materials used, and no figures for production in Western Australia were available. Reliable figures for hay and oats are available for South Australia (3), however, and these should be fairly close to costs in this State. For silage no exact figures could be obtained, so an attempt was made to calculate the approximate cost under average conditions.

The average costs obtained as above were:—

	£	s.	d.
Cereal hay, per ton	2	16	5
Silage, per ton	0	17	0
Oats, per bushel	0	2	7

As the hay was fed as chaff it is necessary to add the cost of chaffing; this is, on an average, 12s. 6d. per ton, making the total cost of the chaff £3 8s. 11d.

From these figures the cost per day of the total ration for each lot of 20 sheep was calculated, and the results so obtained are given in Table VIII.

TABLE VIII.

Cost of Rations per day.

Lot No.	Period.*	Chaff.	Silage.	Oats.	Total.
		d.	d.	d.	d.
1	Whole	5·54	...	...	5·54
2	1st	...	3·64	...	3·64
	2nd	...	4·55	...	4·55
3	1st	...	...	7·75	7·75
	2nd	...	...	11·62	11·62
4	1st	3·69	...	3·88	7·57
	2nd	3·69	...	5·81	9·50
5	1st	...	2·72	3·88	6·60
	2nd	...	2·72	5·81	8·53

The total cost of the various rations for the whole period of the experiment is given in Table IX.

TABLE IX.

Total Cost of Rations.

Lot No.	Total Cost.
	£ s. d.
1	2 6 2
2	1 14 3
3	4 1 0
4	3 11 3
5	3 3 3

At the prices employed it is obvious that the two coarse fodders are decidedly the least costly. Next in order comes oats + silage, then oats + chaff, while oats alone was the most expensive supplement. Taking live-weights into account, therefore, it is apparent that where silage is available a mixture of silage and oats is the most suitable supplement to use for maintenance of sheep on dry stubble.

Estimate of Experimental Error.—In making practical deductions from average results, whether in crop manuring or in feeding tests with livestock, it is necessary to analyse carefully the experimental data in order to avoid false conclusions. Thus in an experiment involving the live-weight of animals it is expected that there will be wide variation in the changes of weights between different animals in the same lot owing to subtle differences in the individual.

* First period up to 12th May. Second period 12th May to end.

In order to minimise the effect of these variations it is most desirable that large numbers of individuals should be included in each lot.*

In Table I. of Appendix are given the initial live-weight of each sheep and the changes in weight, both absolute and as percentages of the original weight. From the percentage variations are calculated the standard deviation for each lot.

In Table X. are given the number of sheep in each lot, the range of the variations in weight, the mean percentage variations with their probable errors and the standard deviations for each lot.

Table X.

Lot No.	No. of sheep.	Range of variation.	Mean per cent. variation.	Standard deviation.
				σ
1	18	—2·7 to —23·3	—17·2 ± ·164	4·39
2	19	—9·6 to —24·4	—16·5 ± ·142	4·00
3	17	+10·6 to —14·6	—4·7 ± ·223	5·63
4	17	+1·3 to —26·2	—9·1 ± ·239	6·02
5	16	+9·4 to —13·5	—4·6 ± ·282	6·69

It will be seen that the range of variations is large, as was expected, being 14.8 in the smallest case (Lot 2) and as much as 27.5 in the largest (Lot 4). This bears out the need for large numbers in order to secure a reliable average.

To test the significance of the differences between the means of the various lots, use is made of the equation for the standard error of the difference between two means (4), viz.:—

$$\epsilon_{12} = \sqrt{\frac{\sigma_1^2}{n_1} + \frac{\sigma_2^2}{n_2}}$$

The difference between each pair of means with its standard error calculated from this equation are given in Table XI.

Table XI.

Differences between means and S.E. of differences.

Pairs of Lots.	Differences.	S.E.	Pairs of Lots.	Differences.	S.E.
1 and 2 ...	0·7	1·38	2 and 4	7·4	1·73
1 and 3 ...	12·5	1·71	2 and 5	11·9	1·91
1 and 4 ...	8·1	1·79	3 and 4	4·4	2·00
1 and 5 ...	12·6	1·97	3 and 5	0·1	2·16
2 and 3 ...	11·8	1·64	4 and 5	4·5	2·22

A study of this table reveals that the differences which may be regarded as significant are those between Lot 1 and each of the last three lots and between Lot 2 and each of the same lots. The differences in the variation in weight between Lots 3 and 4 and between Lots 4 and 5 cannot be regarded as certainly

* Wood and Stratton calculated that where a difference of effect as small as 10 per cent. was expected, not less than 29 animals should be used in each Lot. *Journ. Ag. Sc.* III., 432.

significant, but are probably so as the difference in each case is more than twice the standard error. The differences between Lots 1 and 2 and between Lots 3 and 5 must be regarded as of no significance.

Wool.—At the end of the experiment the sheep in all lots were examined closely by the lecturer in wool-classing at the College to determine whether any changes had taken place in the wool.

He found that in Lots 1 and 2 there had been a definite fining off of the fibre since the inception of the experiment, presumably due to malnutrition. In the other three lots a slight change was noticeable in the wool of some of the sheep, but there was less change in Lot 5 than in either Lot 3 or Lot 4.

Health.—The general health of the experimental animals, except for a slight skin affection of the mouth in Lot 1 which lasted about a fortnight, was good throughout; the sheep in Lots 1 and 2, however, became rather weak.

It is of interest to note that of the ewes which lambed, those in Lots 1 and 2 were unable to rear their lambs owing to lack of milk, while all those in the other lots could provide an adequate supply.

Relation of Live-weight to Temperature.—As previously noted (see page 7) it appeared, on one occasion, that temperature had a direct effect on the live weight of the sheep since all lots were similarly affected. This led the writer to investigate further whether there might be any connection between temperature and live-weight variations. The average live-weight of all the sheep in the experiment, at successive weighings, and the daily temperatures were plotted on the same sheet and the graphs of the live-weights and of maximum and mean temperatures appeared to have many points in common. The coefficient of correlation between live-weight and each of the series of temperatures was then calculated, and these are given in Table XII.

TABLE XII.

Correlation of live-weight with temperature.

Live-weight correlated with.	Coefficient of correlation.	
Max. temperatures	+·873	±·044
Min. temperatures	+·595	±·121
Mean temperatures	+·782	±·073

The Pearsonian coefficient of correlation may vary from +1 to −1. A coefficient of +1 indicates absolute direct correlation, a coefficient of −1 indicates absolute inverse correlation, while a coefficient of 0 shows entire absence of correlation; further, a coefficient to be significant should be more than six times its probable error.

It will be noted that in the case of the minimum temperatures the coefficient, although fairly high, is less than five times its probable error and cannot, therefore, be regarded as significant; in the case of the other two temperature series, however, the coefficient shows a very high degree of correlation and as the probable errors are small they are certainly significant.

SUMMARY AND CONCLUSIONS.

1. Experiments were carried out in the supplementary feeding of sheep with five lots of from 16 to 19 sheep each. The experiments commenced on 24th March, 1930, and covered a period of just over fourteen weeks, ending on 2nd July. No sheep died during the experiments.

2. The five supplementary rations tried were chaff, silage, oats, chaff + oats and silage + oats. The amounts fed were intended to be approximately equal in energy value and were fed as a supplement to a basal ration of wheaten straw.

3. Of these five rations oats alone and silage + oats gave the best results, then came chaff + oats. Chaff alone and silage gave the poorest results. These latter appear to be definitely unsuitable by themselves as a supplement, but are satisfactory mixed with oats; this applies specially to silage. Oats by itself appears to be a satisfactory supplement. It would appear, therefore, that a store of oats is a valuable asset to a sheep farmer.

4. It seems likely that the factor limiting the value of certain of the feeds tried is protein, as the feeds which failed were definitely deficient in this nutrient. On dry pastures, however, if protein is sufficient, silage becomes of value on account of its laxative properties.

5. From the small numbers available it is unsafe to generalise, but it appears likely that chaff alone and silage alone are unsuitable as a supplementary ration for lambing ewes.

6. On the basis of the values quoted for the various fodders, silage is definitely the least costly with chaff next; as, however, these by themselves fall short of protein requirement for a maintenance ration on stubble pasture, the cost factor here is little relevant. Of the other three rations, silage + oats was the least costly, chaff + oats next, while oats alone ranked highest. Variation of quantities in the mixtures would of course alter the costs somewhat, but it appears safe to say that, with values approximating those quoted, a mixture of oats with silage would be the most satisfactory supplement to use.

7. It is obvious from the condition of many of the sheep in the agricultural districts at the beginning of winter that more attention should be paid by farmers to the hand-feeding of their stock. It is clear from the results of this experiment that it is not enough merely to supply even large quantities of such fodders as chaff and silage, but that where these are fed some food relatively rich in protein should be provided along with them. Oats appear to be such a food, and although oats are satisfactory when fed alone, it is more economical on dry pasture to feed them along with silage.

Acknowledgments.—My thanks are due to Professor Paterson, of the University of Western Australia, and to Mr. H. J. Hughes, Principal of the Muresk Agricultural College, for their many helpful suggestions with regard to this experiment and for assistance in the preparation of this paper.

References.

(1.) Kellner, O.—Scientific Feeding of Animals. Trans. by Goodwin, 1926.

(2.) Wood, T. B.—Rations for Livestock. Misc. Pub. 32. Min. of Agric. and Fisheries, 1930.

(3.) South Australian Journal of Agriculture, XXXIII., 402, 406.

(4.) Engledow, F. L., and Yule, G. Udny. Principles and Practice of Yield Trials, 1928.

APPENDIX.

TABLE I.

Lot 1.				Lot 2.				Lot 3.				Lot 4.				Lot 5.			
Sheep No.	Initial live-weight.	Variation.		Sheep No.	Initial live-weight.	Variation.		Sheep No.	Initial live-weight.	Variation.		Sheep No.	Initial live-weight.	Variation.		Sheep No.	Initial live-weight.	Variation.	
		Absolute.	Percentage of Initial weight.			Absolute.	Percentage of Initial weight.			Absolute.	Percentage of Initial weight.			Absolute.	Percentage of Initial weight.			Absolute.	Percentage of Initial weight.
	lbs.	lbs.	%		lbs.	lbs.	%		lbs.	lbs.	%		lbs.	lbs.	%		lbs.	lbs.	%
701	76·0	—14·0	—18·8	706	78·0	—14·0	—18·0	712	86·0	—1·5	—1·7	718	83·0	—4·0	—4·8	722	78·0	—4·0	- 5·1
702	81·5	—16·5	—20·2	707	72·5	—17·0	—23·4	713	70·0	—5·0	—7·1	719	77·5	—4·0	—5·2	723	71·5	— 6·0	— 8·4
703	97·0	—13·5	—13·9	708	82·0	—13·5	—16·5	714	80·5	—6·0	—7·1	720	84·5	—7·5	—8·9	725	81·5	—10·5	- 12·9
704	83·1	—14·0	—16·9	709	74·0	—10·5	—14·2	715	71·5	—9·0	—12·6	732	88·0	—23·0	—26·2	735	78·5	+5·0	+ 6·4
726	82·0	—18·0	—22·0	710	86·5	—15·0	—17·3	731	79·5	—0·5	—0·6	739	75·5	+1·0	+1·3	736	66·0	—4·5	- 6·8
741	68·5	- 13·0	—19·0	728	88·0	—15·0	—17·0	744	74·5	—4·5	- 6·0	740	70·5	—6·0	- 8·5	738	78·5	—6·0	- 7·6
747	72·0	—11·0	—15·3	729	81·5	—12·5	—15·3	750	69·0	—5·5	—8·0	745	69·5	—6·0	—8·6	748	82·0	+1·5	+1·8
749	67·5	—11·5	—17·0	742	67·5	—16·5	—24·4	755	75·5	—11·0	—14·6	754	68·0	—6·0	—8·8	753	69·5	+6·5	+9·4
752	71·0	—10·0	—14·1	746	69·5	—11·0	—15·8	760	72·5	—3·0	—4·1	759	79·5	—6·0	—7·5	758	68·0	—5·0	- 7·4
757	75·0	—2·0	—2·7	751	73·0	—15·0	—20·6	765	74·5	—4·0	—5·4	766	76·0	—4·0	—5·3	770	70·5	—6·0	- 8·5
762	73·0	—17·0	—23·3	756	67·0	— 9·0	—13·4	769	68·0	+7·0	+10·6	767	66·5	- 11·5	—17·3	777	65·0	—3·0	- 4·6
763	68·5	—14·0	—20·4	761	73·0	—7·0	—9·6	775	63·5	—5·5	—8·7	776	76·0	—1·0	—1·3	778	71·5	—9·5	—13·3
772	64·5	—11·5	—17·8	764	71·5	—15·0	—21·0	781	73·0	+1·0	+1·4	779	70·0	—5·5	—7·9	786	77·0	+3·0	+ 3·9
773	68·0	—12·5	—18·4	771	67·0	—8·5	—12·7	785	69·5	—2·0	—2·9	783	62·0	—6·5	—10·5	788	65·5	—4·0	- 6·1
782	73·0	—12·0	—16·4	780	63·5	—9·0	—14·2	789	64·5	—5·5	—8·5	787	74·0	—7·5	—10·1	795	63·0	—8·5	—13·5
791	62·0	—13·0	—21·0	784	72·5	—9·5	—13·1	793	62·5	0·0	0·0	794	64·5	—9·5	—14·7	796	61·5	—1·0	—1·6
800	61·0	—10·5	—17·9	790	78·5	—7·5	—9·6	798	61·5	—3·0	—4·9	797	64·0	—6·5	—10·2				
801	63·5	—9·0	—14·2	792	58·5	—11·0	—18·8											Total	- 74·3
		Total	—309·3	799	64·0	—12·0	—18·8			Total	—80·2			Total	—154·5				
		Mean	—17·2			Total	—313·7			Mean	—4·7			Mean	—9 1			Mean	—4·6
						Mean	—16·5												

AGRICULTURAL SEEDS AND THEIR WEED-SEED IMPURITIES.

H. G. ELLIOTT, Dip. Agr., Assistant Plant Pathologist.

(*Continued from page 577, Vol. 7.*)

Scientific Name.	Common Name.
7. PAPILIONACEAE.	
i. Medicago sativa	Lucerne
Containing :—	
A. *Legumes*—	
Medicago denticulata	Burr Medic (2)
M. lupulina	Black Medic (3)
Melilotus spp.	Melilot (5)
Trifolium dubium	Suckling Clover
T. incarnatum	Crimson Clover
T. pratense	Red Clover (5)
T. repens	White Clover
B. *Grasses*—	
Agrostis sp.	Bent Grass
Dactylis glomerata	Cocksfoot
Lolium perenne	Perennial Rye-grass (2)
Setaria italica	Italian millet (6)
C. *Other Weeds*—	
Amaranthus retroflexus	Pigweed (5)
Artemisia sp.	Wormwood
Brassica arvense	Wild Mustard
B. nigra	Black Mustard (2)
*Carduus lanceolatus	Spear Thistle (7)
Carum sp.	Caraway
Chenopodium album	Mexican Spinach (2)
Cichorium intybus	Chicory
*Echium sp.	Viper's Bugloss (2)
Geranium molle	Crowfoot
*Iva axillaris	Poverty weed
Plantago lanceolata	Ribgrass (8)
Polygonum aviculare	Wireweed (2)
*P. convolvulus	Bindweed (2)
Prunella vulgaris	Selfheal (3)
Rumex acetosella	Sorrel (6)
ii. Medicago denticulata	Burr Trefoil
Containing :—	
A. *Legumes*—	
Medicago sativa	Lucerne
Trifolium incarnatum	Crimson Clover
T. subterraneum	Sub. Clover (2)
B. *Grasses*—	
Bromus maximus	Spear Grass
Bromus hordeaceus	Soft Brome
Dactylis glomerata	Cocksfoot
Holcus lanatus	Yorkshire Fog
Hordeum murinum	Barley Grass (3)

Scientific Name.	Common Name.
C. *Other Weeds*—	
Erodium sp.	Crowfoot (2)
Plantago lanceolata	Ribgrass
Rumex acetosella	Sorrel (4)
Rumex spp.	Docks (2)
Sonchus oleracea	Milk Thistle (2)
iii. Melilotus alba	Bokhara Clover
Containing :—	
A. *Legumes*—	
Medicago lupulina	English Trefoil (2)
M sativa	Lucerne
Melilotus indica	King Island Melilot
B. *Grasses*—	
Setaria viridis	Pigeon Grass
C. *Others*—	
Amaranthus retroflexus	Pigweed
Geranium molle	Crowfoot
Plantago major	Large Plantain (2)
Rumex acetosella	Sorrel
Silene gallica	French Catchfly
Stellaria media	Chickweed
iv. Trifolium dubium	Suckling Clover
Containing :—	
A. *Legumes*—	
Trifolium glomeratum	Cluster Clover (2)
T. hybridum	Alsike Clover
T. pratense	Red Clover
T. repens	White Clover
B. *Grasses*—	
Holcus lanatus	Yorkshire Fog (6)
Phleum pratense	Timothy
C. *Other Weeds*—	
Amaranthus retroflexus	Pigweed (3)
Anagallis arvensis	Pimpernel
Cerastium vulgatum	Chickweed (2)
Geranium molle	Crowfoot
Juncus sp.	Toadrush
Plantago lanceolata	Ribgrass (3)
Rumex acetosella	Sorrel (6)
Sherardia arvensis	Field Madder (2)
Silene gallica	French Catchfly (2)
Spergula arvensis	Spurry
Stellaria media	Chickweed (2)
v. Trifolium hybridum	Alsike Clover
Containing :—	
A. *Legumes*—	
Medicago lupulina	English Trefoil
Trifolium dubium	Suckling Clover (2)
T. glomeratum	Cluster Clover (3)
T. pratense	Red Clover (2)
T. repens	White Clover (4)
T. subterraneum	Subterranean Clover

Scientific Name.	Common Name.
B. *Grasses*—	
Holcus lanatus	Yorkshire Fog (4)
Phleum pratense	Timothy (6)
Poa sp.	Winter Grass
C. *Other Weeds*—	
Amaranthus retroflexus	Pigweed
Arenaria sp.	Sand Spurry
Capsella bursa-pastoris	Shepherd's Purse
Geranium molle	Crowfoot (2)
Lepidium ruderale	Wild Cress
Lychnis alba	White Campion
Plantago lanceolata	Ribgrass (3)
P. major	Large Plantain
*Reseda luteola	Wild Mignonette
Rumex acetosella	Sorrel (5)
Rumex spp.	Docks (3)
Sherardia arvensis	Field Madder
Silene noctiflora	Catchfly (2)
Stellaria media	Chickweed (3)
Thlaspi arvense	Stinkweed
vi. Trifolium repens	White Clover
Containing :—	
A. *Legumes*—	
Lotus hispidus	Boyd's Clover (3)
Medicago denticulata	Burr Medic (3)
Trifolium agrarium	Hop Clover (3)
T. arvense	Hare's Foot Clover
T. dubium	Suckling Clover (9)
T. incarnatum	Crimson Clover
T. hybridum	Alsike Clover
T. pratense	Red Clover
B. *Grasses*—	
Holcus lanatus	Yorkshire Fog (6)
Lolium perenne	Perennial Rye-grass (2)
Phalaris minor	Canary Grass
C. *Other Weeds*—	
Amaranthus retroflexus	Pigweed (2)
Anagallis arvensis	Pimpernel
*Carduus lanceolatus	Spear Thistle
Chenopodium album	Mexican Spinach (3)
Cichorium intybus	Chicory (3)
*Cuscuta spp.	Dodder (4)
Geranium molle	Crowfoot (3)
Juncus sp.	Toadrush
Lychnis alba	White Campion (2)
Myosotis arvensis	Forget me not (4)
Plantago lanceolata	Ribgrass (18)
P. major	Large Plantain (2)
Prunella vulgaris	Selfheal
Ranunculus sp.	Buttercup
*Reseda luteola	Wild Mignonette
Rumex acetosella	Sorrel (18)
Rumex spp.	Docks (2)
Sherardia arvensis	Field Madder (4)
Silene gallica	French Catchfly (6)
S. noctiflora	Catchfly (2)
Spergula arvensis	Spurry
Stellaria media	Chickweed (3)

Scientific Name.	Common Name.
vii. Trifolium cernuum	Drooping Flowered Clover
Containing :—	
A. *Legumes*—	
Trifolium agrarium	Hop Clover (2)
T. dubium	Suckling Clover (2)
T. glomeratum	Cluster Clover (5)
T. tomentosum	Woolly Clover (2)
B. *Grasses*—	
Aira caryophyllea	Fairy Grass (2)
Bromus maximus	Brome Grass
B. hordeaceus	Soft Brome
Festuca bromoides	Silver Grass (2)
Holcus lanatus	Yorkshire Fog
Hordeum murinum	Barley Grass (2)
Lolium perenne	Perennial Rye-grass (2)
Phleum pratense	Timothy
C. *Other Weeds*—	
*Bartsia viscosa	Yellow Weed (2)
Hypochœris glabra	Catsear (2)
H. radicata	Flatweed (2)
Juncus spp.	Toadrush
Rumex acetosella	Sorrel (4)
Silene noctiflora	Catchfly (2)
viii. Trifolium glomeratum	Cluster Clover
Containing :—	
A. *Legumes*—	
Melilotus indica	King Island Melilot (2)
Trifolium agrarium	Hop Clover (2)
T. arvense	Hare's Foot Clover (2)
T. dubium	Yellow Suckling Clover (7)
T. pratense	Red Clover
T. repens	White Clover (2)
T. tomentosum	Woolly Clover
B. *Grasses*—	
Holcus lanatus	Yorkshire Fog (2)
C. *Other Weeds*—	
Cerastium vulgatum	Chickweed (2)
Hypochœris radicata	Flatweed
Plantago lanceolata	Ribgrass (2)
Rumex acetosella	Sorrel (7)
Silene inflata	Campion
Sisymbrium officinale	Hedge Mustard (2)
Tunica prolifera	Wild Pink
ix. Trifolium Alexandrinum	Berseem Clover
Containing :—	
A. *Legumes*—	
Medicago lupulina	English Trefoil
Melilotus indica	King Island Melilot (3)
B. *Grasses*—	
Lolium perenne	Perennial Rye-grass (2)

Scientific Name.	Common Name.
C. *Other Weeds*—	
Brassica alba	White Mustard
B. arvense	Wild Mustard
B. nigra	Black Mustard (2)
Cichorium intybus	Chicory (7)
Rumex spp.	Docks (6)
Sonchus oleracea	Milk Thistle
x. Trifolium incarnatum	Crimson Clover
Containing :—	
A. *Legumes*—	
Medicago lupulira	English Trefoil (6)
Melilotus alba	Bokhara Clover
Trifolium dubium	Suckling Clover
T. pratense	Red Clover
T. repens	White Clover
Vicia sativa	Common Vetch
B. *Grasses*—	
Alopecurus sp.	Foxtail
Bromus hordeaceus	Soft Brome
Lolium perenne	Perennial Rye-grass
C. *Other Weeds*—	
*Brassica sinapistrum	Charlock (3)
Brassica spp.	Mustards (9)
*Centaurea cyaneus	Star Thistle
Cerastium vulgatum	Mouse Eared Chickweed
Chenopodium album	Mexican Spinach
Chrysanthemum leucanthemum	Ox-eye Daisy
*Cnicus arvensis	Californian Thistle
Crepis virens	Smooth Crepis
Geranium dissectum	Wild Geranium (10)
G. molle	Cranebill (3)
*Guizotia abyssinica	
Lychnis alba	White Campion (4)
Plantago lanceolata	Ribgrass (2)
Poterium sanguisorba	Sheep's Burnet (2)
*Polygonum sp.	Smart Weed
Ranunculus repens	Creeping Buttercup (3)
Rumex acetosella	Sorrel (6)
Rumex spp.	Docks (3)
Scandix Pecten-Veneris	Shepherd's Needle
Sherardia arvensis	Field Madder (5)
Silene noctiflora	Catchfly (2)
Stellaria media	Chickweed
xi. Trifolium pratense perenne	Cow Grass
Containing :—	
A. *Legumes*—	
Medicago lupulina	English Trefoil (5)
Trifolium incarnatum	Crimson Clover (2)
T. repens	White Clover (3)
B. *Grasses*—	
Danthonia sp.	Wallaby Grass
Lolium perenne	Perennial Rye-grass (2)
Phleum pratense	Timothy

Scientific Name.	Common Name.
C. *Other Weeds*—	
Apium graveolens	Celery
Brassica spp.	Mustard (2)
*Carduus lanceolatus	Spear Thistle (2)
Chrysanthemum leucanthemum	Ox-eye Daisy
Cichorium intybus	Chicory
*Cuscuta spp.	Dodder
Daucus carota	Carrot
Lychnis alba	White Campion
Malva sp.	Mallow
Mentha sp.	Mint
Plantago lanceolata	Ribgrass (2)
*Polygonum aviculare	Wireweed
Prunella vulgaris	Selfheal (2)
Rumex acetosella	Sorrel (3)
Rumex spp.	Docks (4)
Silene noctiflora	Catchfly (5)
Stellaria media	Chickweed (2)
xii. Trifolium subterraneum	Subterranean Clover
Containing :—	
A. *Legumes*—	
Medicago denticulata	Burr Medic (8)
M. lupulina	Black Medic (2)
Trifolium agrarium	Hop Clover (8)
T. cernuum	Drooping Flowered Clover (2)
T. dubium	Yellow Suckling Clover (2)
T. glomeratum	Cluster Clover (10)
T. tomentosum	Woolly Clover (4)
B. *Grasses*—	
Aira caryophylla	Silvery Grass (3)
Alopecurus pratense	Foxtail (3)
Andropogon (Sorghum) sudanense	Sudan Grass (2)
Avena sativa	Oat (6)
Bromus maritensis	Spear Grass (6)
B. maximus	Large Broma (25)
B. hordeaceus	Soft Brome (6)
B. sterilis	Sterile Brome (3)
Cynodon dactylon	Couch Grass
Festuca bromoides	Hair Grass (2)
F. Myuros	Silver Grass (6)
Hordeum jubatum	Barley Grass (2)
H. murinum	Barley Grass (22)
H. vulgare	Barley (2)
Lolium perenne	Perennial Rye-grass (7)
L. temulentum	Drake (7)
Paspalum dilatatum	Paspalum (2)
Setaria spp.	Millet (5)
Sorghum saccaratum	Sweet Sorghum (2)
Stipa spp.	Native Spear Grasses (2)
Triticum sativum	Wheat (2)
C. *Other Weeds*—	
*Bartsia viscosa	Yellow Weed (2)
Brassica spp.	Mustards (4)
*Cuscuta spp.	Dodder (2)
Cryptostemma calendulaceum	Cape Weed (2)
Erodium spp.	Crowfoot (2)
Hypochœris glabra	Catsear (2)
H. radicata	Flatweed (4)
*Inula graveolens	Stinkwort
Juncus sp.	Native Rush (7)

Scientific Name.	Common Name.
C. *Other Weeds*—continued.	
Plantago lanceolata	Ribgrass (2)
P. major	Large Plantain
*Polygonum sp.	Bindweed
*Romulea rosea	Guildford Grass (9)
Rumex acetosella	Sorrel (4)
Rumex spp.	Docks (12)
Salvia sp.	Salvia (2)
Silene noctiflora	Catchfly (2)
Sonchus oleracea	Milk Thistle (6)
Tunica prolifera	Wild Pink (2)
xiii. Lotus corniculatus	Minor Birdsfoot Trefoil
Containing :—	
A. *Legumes*—	
Trifolium hybridum	Alsike Clover
T. pratense	Red Clover (2)
B. *Other Weeds*—	
*Asperula sp.	Squinancy Wort (2)
Lychnis alba	White Campion (2)
Plantago lanceolata	Ribgrass (2)
Rumex spp.	Docks
xiv. Lotus uliginosus	Lotus major
Containing :—	
A. *Legumes*—	
Lotus angustissimus	Birdsfoot Trefoil (7)
L. hispidus	Boyd's Clover (2)
L. corniculatus	Minor Birdsfoot Trefoil (2)
Trifolium arvense	Haresfoot Trefoil
T. dubium	Suckling Clover (4)
T. glomeratum	Cluster Clover (2)
T. hybridum	Alsike Clover (2)
T. pratense	Red Clover
T. repens	White Clover (10)
T. tomentosum	Woolly Clover
B. *Grasses*—	
Anthoxanthum odoratum	Sweet Vernal
Cynosurus cristatus	Crested Dogstail
Holcus lanatus	Yorkshire Fog (7)
Phleum pratense	Timothy (4)
Poa sp.	Annual Winter Grass
Setaria viridis	Pigeon Grass
C. *Other Weeds*—	
*Asperula sp.	Squinancy Wort (2)
*Cuscuta sp.	Dodder
Geranium sp.	Crowfoot
Juncus sp.	Rush
Plantago lanceolata	Ribgrass (8)
P. major	Large Plantain (2)
Prunella vulgaris	Selfheal (2)
Rumex acetosella	Sorrel (10)
Rumex spp.	Docks (2)
Silene noctiflora	Catchfly (3)
Spergula arvensis	Spurry (2)

Scientific Name.	Common Name.
xv. Lotus hispidus	Boyd's Clover
Containing :—	
A. *Grasses*—	
Agrostis vulgaris	Red Top
Aira caryophyllea	Silvery Grass
Festuca Myuros	Silver Grass
Holcus lanatus	Yorkshire Fog (3)
Phleum pratense	Timothy
B. *Other Weeds*—	
Amaranthus retroflexus	Pigweed
Hypochoeris radicata	Flatweed
Plantago lanceolata	Ribgrass (3)
Rumex acetosella	Sorrel (2)
Rumex spp.	Docks (2)
xvi. Vicia spp.	Vetches
Containing :—	
A. *Grasses*—	
Avena sativa	Oat (2)
Hordeum vulgare	Barley
Triticum sativum	Wheat
B. *Other Weeds*—	
*Galium aparine	Cleavers
*Lychnis Githago	Corncockle
xvii. Pisum arvense	Field Peas
Containing :—	
A. *Legumes*—	
Medicago denticulata	Burr Modic
B. *Grasses*—	
Avena sativa	Oat
Hordeum vulgare	Barley
C. *Other Weeds*—	
Fumaria officinalis	Fumitory
Galium aparine	Cleavers
xviii. Glycine max	Soy Bean
Containing :—	
*Xanthium spp.	Burrs (10)
8. LINACEAE.	
i. Linum usitatissimum	Linseed (Flax)
Containing :—	
A. *Grasses*—	
Setaria glauca	Pigeon Grass
Triticum sativum	Wheat
B. *Other Weeds*—	
Apium sp.	Celery
Brassica spp.	Mustards (12)
Chenopodium album	Mexican Spinach (2)
Commelina sativa	False Flax
Raphanus sativa	Radish
Rumex spp.	Docks (3)
Scabiosa sp.	Scabious
Spergula arvensis	Spurry

Scientific Name.	Common Name.
9. UMBELLIFERAE.	
i. Apium graveolens var dulce	Celery
Containing :—	
A. *Grasses*—	
Setaria italica	Italian Millet (3)
B. *Other Weeds*—	
Picris sp.	Ox Tongue
Rumex sp.	Dock
ii. Petroselinum sativum	Parsley
Containing :—	
Amaranthus retroflexus	Pigweed (3)
Brassica spp.	Mustards (2)
Plantago lanceolata	Ribgrass
iii. Pastinacea sativa	Parsnip
Containing :—	
Brassica nigra	Black Mustard (3)
Hordeum vulgare	Barley
iv. Daucus carota	Carrot
Containing :—	
Allium sp.	Onion
Amaranthus retroflexus	Pigweed
Plantago lanceolata	Ribgrass (3)
Polygonum aviculare	Wireweed
*P. convolvulus	Bindweed (2)
Rumex acetosella	Sorrel (5)
Rumex spp.	Docks
10. PLANTAGINACEAE.	
i. Plantago lanceolata	Ribgrass
Containing :—	
A. *Legumes*—	
Trifolium dubium	Suckling Clover
T. pratense	Red Clover
T. repens	White Clover
B. *Grasses*—	
Cynosurus cristatus	Crested Dogstail
Holcus lanatus	Yorkshire Fog
Lolium perenne	Perennial Rye-grass
Phalaris minor	Canary Grass
C. *Other Weeds*—	
Brassica sp.	Mustard
Rumex acetosella	Sorrel
11. COMPOSITAE.	
i. Lactuca sativa	Lettuce
Containing :—	
Amaranthus retroflexus	Pigweed (2)
Chenopodium album	Mexican Spinach
Juncus sp.	Rush
Reseda luteola	Wild Mignonette
Stellaria media	Chickweed

COOL DAIRIES FOR COOL CREAM.

M. CULLITY, Agricultural Adviser.

During the past summer many suppliers of cream found that it was again difficult to keep their cream up to choice quality. For some reason that baffles them, in a great many cases their cream is often second grade or else what is known as "border-line cream." It frequently happens that the farmer has cream of this latter type, but knows nothing of it if the grader decides it is good enough to use in the first grade vat. Just good enough is not good enough, and it appears to be very difficult to bring this home to the dairy farmer. Various causes are at work to bring about this lowering to or below "border-line" standard, and it is my intention in these notes to draw attention to one factor which has a considerable effect, although in many cases the application of this factor is like liming land that is sour through faulty drainage. The sourness is corrected, but the cause of it is not touched. Similarly with the subject to be discussed, the matter of the production of clean milk and cream, the cleanliness of utensils, the health of the herd, etc., should be treated first; but it seems opportune to me, while pointing to the necessity for cleanliness throughout all phases of the production of cream, to draw attention to the safe-guarding effect of cooling the cream immediately after separation and the keeping of it cool.

Very few of our farmers now follow the faulty practice of separating warm cream into a can of cold cream, because it has been proved to them that this practice is very detrimental to quality. They know that the result of raising the temperature of the cool cream is to facilitate the multiplication of the bacteria therein, with the result that the cream develops cheesy, rank or unclean flavours. The bacteria that are in cream have an optimum temperature for their multiplication, above which the rate of division declines till a point is reached at which they are destroyed. This fact is utilised in pasteurisation. Also below the optimum, the further the temperature is reduced the slower the rate of increase becomes. This means that the cooler cream is kept the slower bacterial change will carry on. Also the quicker the cream is cooled, the less bacterial increase will occur. It might be necessary to say that of all the flavours to which cream is prone, those due to bacterial change are among the worst.

To give an indication of how quickly bacteria will increase their rate of multiplication with a rise in temperature, the following figures are useful:—

Number Bacteria c.c. at outset.	In 12 hours at 50 deg.	In 12 hours at 70 deg.	In 50 hours at 50 deg.	In 50 hours at 70 deg.	No. of hours before Curdling at 50 deg.	No. of hours before Curdling at 70 deg.
46,000	39,000	249,500	156,000	542,000,000	190	56
47,000	44,800	360,000	127,500	792,000,000 36 hours	289	36
50,000	35,000	800,000	160,000	2,560,000,000, 42 hours	172	42

Bulletin 26, Storrs Sta., Conn.

Our concern is now to illustrate how this cooling may be brought about. (See "Cooling of Milk and Cream," by G. K. Baron-Hay, Western Australian Department of Agriculture *Journal*, December, 1930.)

To those farmers who have a supply of cold water laid on to the dairy, the problem is simple. There are on the market various small cooling devices of the

type illustrated in Fig. 1 of Mr. Baron-Hay's article referred to above, which are very efficient. In appearance these remind one of the household washboard. Where the ribs are in the washboard are thin tubes through which cold water is flowing. The cream is received from the outlet of the separator into a tray from which it flows in a thin layer over the exterior of these tubes. The heat of the cream is taken up by the water which passes away.

This method also has another advantage in aeration. The passage of this thin layer of cream would have the effect of allowing any volatile flavours to escape.

The temperature of the cream so cooled should be maintained. This is quite easily done by having a tub in which the cream cans can be placed, and which is kept continuously full of cold water. Better still, where cold water can be kept running, as in Fig. II., "Cooling of Milk and Cream," by G. K. Baron-Hay, Western Australian Department of Agriculture *Journal*, December, 1930.

Trellis carrying vine erected over dairy.
W. J. Reynolds, Manjimup.

Of course there is a very serious objection to this for those who have not a good supply of water laid on, or who cannot afford a cooler of the type illustrated. For these a modification is suggested which, though not as efficient as that just described, is very much better than not cooling at all. This is in having the vessel with the freshly separated cream stand in a larger vessel of cold water. This should be changed two or three times during cooling, as it takes up the heat from the cream. This method, though crude, has the effect of reducing the cream temperature five times as fast as where air cooling only is used. The cream cans can also be kept in a tub of cold water.

Another factor of importance is the dairy. Often one finds these stuffy, ill-ventilated and warm; some even hot. These types of dairies have an undoubtedly bad effect on flavour. The cream absorbs the stuffiness and mustiness, and it can be easily detected by the grader. The warm atmosphere has its effect in keeping up the temperature of the cream as instanced previously. How, then, to remedy

this condition! The first step necessarily will be in arranging ventilation and removing any causes of mustiness. There should be no necessity here for pointing out that a dairy is for the storage of milk and cream, and that other substances, vegetables, meat, chaff, etc., should be kept elsewhere.

Dairy surrounded by lucerne trees.
D. Hunter (sen.), Barronhurst.

To correct the heat various methods are utilised, but the most successful have been where a trellis has been built completely over the dairy, and vines (grapes or passion) trained over it. Any form of creeper giving summer shade would be efficient. This trellis to be quite successful has to be built away from the walls, usually two feet, and about the same distance being kept between the roof and the trellis, thus allowing for shade and a draught of air continuously between the trellis and the dairy. The two illustrations will give an idea of how to do this better than any description. Others, like D. Hunter, plant trees nearby to shelter the building, getting very good results (see illustration). These have been convinced of the necessity for cool dairies, and have taken steps to provide the so necessary coolness. Why do so many others neglect it? Their methods of production are not so superior that their cream does not need to be cool. The time is now approaching when the quality of the cream received at the factories will be more closely checked, so that it will behove those farmers who wish to obtain the highest price for their cream to pay more attention to the details. While the details are neglected, the quality of the cream will be variable.

TRIALS WITH RHENANIA PHOSPHATE FOR WHEAT GROWING, 1930, AT THE MERREDIN EXPERIMENT FARM AND THE WONGAN HILLS LIGHT LANDS FARM.

I. Thomas, Superintendent of Wheat Farms.

Rhenania Phosphate is a phosphatic fertiliser manufactured by the Kali-Chemie Company, Berlin, Germany. It is a high grade ammonium citrate soluble fertiliser, containing 28.4 per cent. ammonium citrate soluble phosphoric acid, and has given satisfactory results in Germany. It has also proved valuable for rice culture in Japan and there is a considerable export to that country and also to Brazil, Chili, Guatemala, etc.

Owing to the generosity of the manufacturers, a quantity of this fertiliser was made available for trials in this State. The cost of this fertiliser in Germany is £5 3s. 9d. per kilogram, the landed cost in Perth being £8 10s. per kilogram (2,204.6 lbs.). This price is equal to approximately £8 13s. a ton. The local price of superphosphate, which contains 22 per cent. phosphoric acid, is £4 10s. per ton. For comparative purposes the unit value of these fertilisers, in Perth, are respectively—

Rhenania Phosphate	6/0
Superphosphate	4/1

A portion of this fertiliser was made available to this Branch for trials with wheat, and experiments were laid down at both the Merredin Experiment Farm and the Wongan Hills Light Lands Farm.

For the purpose of the experiment three plots were required, viz.:—

Plot 1.—Received an application of 150 lbs. of Rhenania Phosphate per acre.

Plot 2.—Received an application of 150 lbs. of Superphosphate per acre (control plot).

Plot 3.—Received an application of 110 lbs. of Rhenania Phosphate per acre.

Plots 1 and 2 thus received the same weight of fertiliser per acre, and Plots 2 and 3 the equivalent quantities of phosphoric acid.

The plots, which were each one-eighth of an acre in area, were repeated five times, the fertiliser being applied with the seed at the time of planting, and the resulting crop was harvested for grain.

TRIALS AT THE MERREDIN EXPERIMENT FARM.

The land on which the experiment was conducted was typical heavy forest country which originally carried a forest of salmon gum and gimlet and which has been in cultivation for many years. The land was ploughed with a disc plough in June, 1929, and was reploughed in August and springtyne cultivated after rain in March. Prior to seeding on 13th May it was cultivated and cross cultivated with a tandem disc implement. The variety Gluyas Early was planted at the rate of 45 lbs. per acre.

The rainfall during 1930, together with 19 years average, is as follows:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1930 ...	...	1	281	186	40	363	137	184	65	34	823	1	41	1,333
Average 19 years	55	56	125	79	130	195	188	140	93	75	821	44	54	1,234

The results obtained are as follows:—

MERREDIN FARM.

RHENANIA PHOSPHATE EXPERIMENT.

Planted on 13th May, 1930. Variety—Gluyas Early. Seed—45lbs. per acre.

Rate of Application of Phosphates per Acre.	Computed Yields per Acre.										Average Yields per acre, 1930.		Per-centage Yields, 1930.
	Sec. 1.		Sec. 2.		Sec. 3.		Sec. 4.		Sec. 5.				
	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	bus.	lbs.	%
150lbs. Rhenania Phosphate	30	56	28	56	29	44	30	0	29	20	29	47	97
150lbs. Superphosphate ...	31	52	29	52	31	12	30	16	30	8	30	40	100
110lbs. Rhenania Phosphate	30	0	27	44	30	0	27	36	28	8	28	42	94

On this farm it was not possible to obtain a piece of land to which no phosphatic fertiliser had previously been applied.

TRIALS AT THE WONGAN HILLS LIGHT LANDS FARM.

At this farm the experiment was conducted on land which, prior to ploughing in 1929, was still in its natural state, the vegetation being chiefly what is known as smoke bush, and the soil is of a light sandy nature.

The working of the land in preparation for the experiment was as follows:—During June and July, 1929, it was ploughed with a disc cultivating plough, and in September and October was cross cultivated with the same implement. In January it was scrub-raked and lightly cultivated with a disc implement in March. It was then tandem disc cultivated prior to seeding. The experiment was planted with the standard midseason variety Nabawa on 23rd April.

The rainfall for Wongan Hills for 1930 and the five years' average is as follows:—

——	Jan.	Feb.	Mar.	Apl.	Growing Period.							Nov.	Dec.	Total for year.
					May.	June.	July.	Aug.	Sept.	Oct.	Total.			
1930 —	7	Nil	53	92	66	367	321	149	90	55	1,048	1	98	1,299
Average 5 years	27	47	112	65	144	282	294	133	77	81	1,011	37	30	1,329

The growth of the plots receiving an application of Rhenania Phosphate was inferior throughout the season compared with the control plots, and this difference was more marked towards maturity, the control plots ripening about ten to twelve days earlier than the Rhenania plots.

The results were as follow:—

WONGAN HILLS LIGHT LANDS FARM.

RHENANIA PHOSPHATE EXPERIMENT.

Planted on 23rd April, 1930. Variety—Nabawa. Seed—45lbs. per acre.

Rate of Application of Phosphates per Acre.	Computed Yields per Acre.					Average Yields per acre, 1930.	Percentage Yields, 1930.
	Sec. 1.	Sec. 2.	Sec. 3.	Sec. 4.	Sec. 5.		
	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	bus. lbs.	%
150lbs. Rhenania Phosphate	9 12	9 20	9 36	9 20	10 8	9 31	55
150lbs. Superphosphate ...	17 36	14 48	17 44	17 12	17 12	17 18	100
110lbs. Rhenania Phosphate	7 52	8 32	8 16	9 12	8 16	8 26	49

The results from this farm, although for one year only, show a significant difference in favour of the superphosphate.

Of the two experiments, that at Wongan Hills is the more striking, as a better comparison can be made between the availability of the two fertilisers because of the low initial phosphoric acid content of the soil and also because it was conducted on virgin land.

It must be borne in mind that there was a considerable residual effect of phosphoric acid at the Merredin Farm, as it was found impossible to carry out the experiment on a piece of land which had not previously received a dressing of a phosphatic fertiliser.

From the results of the trials at both farms, it is unlikely that Rhenania Phosphate will displace superphosphate for wheat growing.

THE M. T. PADBURY TROPHY COMPETITION.

I. THOMAS, Superintendent of Wheat Farms.

This competition was inaugurated as the result of a generous donation made by Mr. M. T. Padbury, President of the Primary Producers' Association, a past President of the Royal Agricultural Society, and a prominent pioneer farmer of this State. The allocation of the funds has been so arranged that a replica of the main shield is awarded to the winner each year of the competition, *i.e.*, the competitor who produces the highest acre yield of wheat per inch of rainfall during the growing season (May 1st to October 31st).

The conditions under which this competition is being conducted are as follow:—

1. The competition will commence with the 1930-31 harvest and continue for a period of 10 years. At the end of that period the trophy will be awarded to the competitor who has taken part in the competition for at least five years, and who obtains the greatest mean average acre yield per inch of rainfall during the conventional growing period. The mean average yield will be computed

from the results of the five seasons in which the competitor produced the highest acre yield per inch of rainfall during the growing period. In the event of a tie the competition will continue between the leading competitors until an advantage is gained by one of them.

2. The conventional growing period for any year will be that decided upon and announced by the Royal Agricultural Society. For the first year and until further notice it has been decided that it will be from May 1st to October 31st, inclusive.

3. Until the end of the competition the trophy will be in the custody of the Royal Agricultural Society, and will be displayed at any agricultural exhibition held by that society.

4. Each year the competitor who obtains the best average acre yield per inch of rainfall during the conventional growing period will be awarded a replica of the trophy. His name will also be inscribed upon a small shield affixed to the trophy.

5. The rainfall upon which the award will be made will be determined by the Commonwealth Meteorologist from the district records, and his decision in this matter will be final.

6. The competition will be limited to those farmers who harvest at least 200 acres of wheat for grain. Where a competitor is financially interested in the crops grown on one or more farms he will be required to supply details regarding the production and marketing of the crops on same, and though usually the award will be made upon the results from the farm nominated by the competitor, yet the Royal Agricultural Society may require that the crops on these farms be included in the competing area.

7. The average yield will be ascertained from the total area—including self-sown crops—harvested for grain and determined from the actual amount of wheat sold as shown by the delivery dockets, plus the amount retained for seed, for home use, or for any other purpose.

8. The method of judging will be as follows:—At a convenient time the area harvested for grain will be measured and the quantity of wheat on hand ascertained. On or before January 31st, the farmer will be required to furnish the judge with a sworn declaration as to the quantity of wheat sold from the competing holding or holdings, and the amount retained for seed and other purposes; the statement regarding the amount sold to be supported by agents' dockets. The judge, after satisfying himself as to the correctness of this statement, will compute the average yield per acre per inch of rainfall during the growing period from the information received.

9. The judge will be appointed by the Director of Agriculture, and his decision will be final.

10. Nominations for this competition will be received by the Royal Agricultural Society up to the 31st October each year.

The acre yields are highly meritorious, and in the case of the winner, 3 bushels 23 lbs. per inch of rainfall constitutes an official record for this State. The previous record was held by Mr. J. McDonald, the winner of the Bateman Cup Competition, 1929/30 season, with an acre yield of 3 bushels 22 lbs. per inch of rainfall.

The results for last season, the first in the competition, are set out below:—

M. T. PADBURY TROPHY COMPETITION, 1930.

Competitor.	Address.	Rainfall during Growing period.	Area Harvested.	Yield.					
				Gross.		Average per Acre.		Average per 1in. Growing period Rain.	
		points.	acres.	bus.	lbs.	bus.	lbs.	bus.	lbs.
Williams, F. A. ...	Mangowine *via* Nungarin	799	337	9,126	50	27	5	3	23
Pascoe Bros. ...	Yalbarrin ...	987	299	9,537	0	31	54	3	14
Haggerty, H. J. ...	Erikin	899	349	8,914	24	25	33	2	51
Barnett, L. T. C. ...	North Wolgoolan	1,062	468	13,908	28	29	43	2	48
Leah, J. H., & Son	Ardath	1,053	406	11,737	46	28	55	2	45
Cusbert, L. C. ...	Bruce Rock ...	987	480	12,118	16	25	15	2	44
Manuel, C. J. ...	Mukinbudin ...	893	248	6,043	5	24	22	2	44
Atkins, F. M., & J. L.	Yanoning Rock ...	796	438	9,362	17	21	23	2	41
Smith, C. & A. H.	Yalbarrin ...	987	1,383	35,890	38	25	57	2	38
Strange, P. A. ...	Yarding	1,053	432	11,856	55	27	27	2	36
Snell, C. & Son ...	Nangeenan ...	894	428	9,495	2	22	11	2	29
Craigie, J.	Yarding	1,053	563	14,632	46	25	59	2	28
Gilham, F. ...	Bencubbin ...	861	496	10,517	22	21	12	2	28
Hammond, J. D. ...	Kellerberrin ...	845	370	7,605	10	20	33	2	26
Tibbs, J. A. ...	Bruce Rock ...	1,047	345	8,699	53	25	13	2	25
Henderson, late J. H.	Gnarming ...	1,142	582	15,668	51	26	55	2	21
Smith, C., & Sons	Yarding	1,053	2,414	59,782	37	24	46	2	21
Creagh Bros., Ltd.	Nungarin ...	840	1,172	22,992	45	19	37	2	20
Lohoar, W. ...	Borden	984	262	5,866	40	22	23	2	16
Allen Bros. ...	Cent. Kumminin	1,047	700	16,003	17	22	52	2	11
Jacob, H. D. ...	Erikin	899	393	7,478	32	19	16	2	9
Reichett, F. W. ...	North Burracoppin	945	1,244	25,006	33	20	6	2	8
Morcombe, P. T. ...	Waddy Forest ...	1,208	490	12,191	7	24	53	2	4
Bishop, H. F. ...	Lake Grace ...	1,260	287	7,272	48	25	20	2	1
Nixon, T., & Sons	Kalannie ...	1,066	4,086	85,040	0	20	49	1	57
Bremner, J. R., & Sons	Corrigin	1,080	1,172	24,364	1	20	47	1	55
Carter, H. R. ...	Three Springs ...	1,219	318	7,412	11	23	19	1	55
Horsman, H., & Sons	Bilbarin	1,080	422	8,588	24	20	21	1	53
Stewart, W. B. ...	Gnowangerup ...	1,225	289	6,578	26	22	46	1	52
White, R. H. ...	Gnowangerup ...	1,225	245	5,535	8	22	36	1	51
Barr, D. F. ...	Shackelton ...	1,137	485	10,053	56	20	44	1	49
Prowse, E. W. ...	Doodlakine ...	843	660	9,485	6	14	22	1	42
Carter, J. S., & G. T.	Benjaberring ...	901	554	8,393	29	15	9	1	41
Garrett, G. ...	Ardath	1,122	642	11,821	57	18	25	1	38
Stewart, T. D. ...	Gnowangerup ...	1,225	209	3,751	15	17	57	1	28
Cowan, C. W. ...	E. Narembeen ...	1,026	883	13,394	19	15	10	1	28
Clark, R. W. ...	Carnamah ...	1,515	687	14,190	9	20	39	1	22
Stevenson, K. J. O.	Watheroo ...	1,571	621	12,360	43	19	54	1	16

EXPERIMENT WITH SHEEP-BRANDING FLUIDS.

PROJECT No. 34.

R. P. ROBERTS, B.Sc.(Agric.), Agricultural Adviser.

This article has been compiled by the writer from information supplied by Mr. H. J. Hughes, Principal of the Muresk Agricultural College, and Messrs. F. L. Shier and J. H. Langfield, Managers of the Chapman and Merredin Experiment Farms, respectively.

In June, 1929, a number of different types of sheep-branding fluids were received for trial from the British Research Association for the Woollen and Worsted Industries.

These were forwarded to the Merredin and Chapman Experiment Farms and to the Muresk Agricultural College for trial. Climatic conditions at these three centres are very similar, the summers being hot and dry and the winters mild and wet.

The Chapman Experiment Farm is situated in the extreme northern portion of the wheat belt, about 30 miles from the coast. The average rainfall is 18.17 inches. The soil is mainly a red sandy loam.

Muresk Agricultural College is on the western edge of the central wheat belt, 65 miles from the coast. The soil varies in character from sand to clay. The average annual rainfall at Northam, nine miles distant, the closest point at which records have been kept, for 50 years is 17.12 inches.

The Merredin Experiment Farm is located in the East-Central wheat belt, 168 miles from the coast. The average annual rainfall is 12.27 inches, and the soil is mostly a red clay loam.

At each of these centres experiments were carried out with the object of determining—

(a) the permanency of the various wool-marking fluids under natural conditions, and

(b) the effect upon the wool.

The procedure was the same at each station.

At least 10 merino sheep, carrying different types of wool, were marked immediately after shearing in September, 1929. Observations regarding durability were made throughout the year. The results of these observations at each of the farms are as follow:—

Chapman Experiment Farm. Sheep branded C↑N.

Types of fluid used—

No. 8—Red.

No. 17—Blue.

No. 19—Green.

Owing to accumulation of dust and grease in the tip the colours were not distinguishable two months after application without opening up the wool. The markings themselves remained clear in outline for a period of about six months.

After that the red and green gradually became indecipherable, but in the case of the blue fluid it was possible, on close inspection, to read the marks up to nine months after application.

When examined at shearing time the following year (September, 1930), all sheep that had been branded with the blue fluid showed traces of the markings, though it was not possible to decipher exactly what the brand was. Many of the sheep branded with the green fluid showed traces of a brand, but others showed no sign whatever.

Of the sheep which had been branded with the red fluid, only two showed any trace of a brand.

The experiment showed that the blue fluid (17) was more lasting than either the green (19) or the red (8). The green lasted fairly well, but the red was quickly washed away with the winter rains.

Merredin Experiment Farm. Sheep branded N↑N.

Types of fluid used—

No. 8—Red.

No. 15—Red.

Owing to accumulation of dust and grease in the tip the colours were not distinguishable two months after application without opening the wool.

The outline of the markings remained clear for about six months. With the beginning of winter they faded out rapidly.

At shearing, in September, 1930, no traces of the brands could be found.

Muresk Agricultural College. Sheep branded M↑C.

Types of fluid used—

No. 17—Blue.

No. 18—Red.

No. 19—Green.

A tin of No. 15 was also forwarded, but was not used in the experiment.

Owing to accumulation of dust and grease in the tip, the actual colours soon became indistinguishable, without opening up the wool. The brands remained clear, however, in all weathers, and were permanent. They were not affected by dipping in November, 1929.

Samples of the branded wool were taken from the sheep immediately prior to shearing in September, 1930. These were passed to Mr. McCallum, Sheep and Wool Inspector, for examination, and were scoured with the exception of the small duplicates enclosed. It was found impossible to remove the marks by scouring. This seriously detracts from the value of the wool both from the grower's and the buyer's point of view.

A summary of results is given below:—

Colour.	Reference No.	Location of Trial.	Duration of Colour.	Durability of the Marking.	Condition at Shearing in September, 1930, one year after application.	—
Red	8	Merredin Experiment Farm...	Owing to dust and grease the colour not distinguishable two months after application without opening up the tip	Fairly clear in outline till beginning of winter, then faded out rapidly	No trace	Samples of branded wool from Muresk were scoured with soap and warm water one year after application, but the marks could not be washed out.
		Chapman Experiment Farm			No trace	
Red	15	Merredin Experiment Farm...		Fairly clear in outline till beginning of winter, then faded out rapidly	No trace	
Blue	17	Muresk Agricultural College...		At Muresk—Permanent ...	At Muresk Colour plainly visible on opening wool	
		Chapman Experiment Farm		Remained fairly clear at Chapman for seven months longer than the other colours	At Chapman Plainly visible on all sheep, though outline generally undecipherable	
Red	18	Muresk Agricultural College...		Permanent	Colour plainly visible on opening wool	
Green ...	19	Muresk Agricultural College...		At Muresk Permanent ...	At Muresk—Colour plainly visible on opening wool	
		Chapman Experiment Farm		At Chapman—Fairly clear till beginning of winter	At Chapman some sheep showed signs of having been branded; on others no trace.	

DISTRICT CHALLENGE SHIELD WHEAT YIELD COMPETITION.

I. Thomas, Superintendent of Wheat Farms.

The past season marked the end of this competition which commenced in 1928 and continued for a period of three years. The progressive results have appeared in previous June issues of this Journal, and these have now been incorporated in the final figures.

The detailed conditions under which the competition was conducted have previously been published. The main feature of the competition, however, was that it was not for individual farmers, but for a team of five farmers nominated by a responsible local body in different districts throughout the Wheat Belt. The awards were made on yields only, and the team which obtained the highest average yield per acre over the three years was adjudged the winner.

The judging was attended to by the officers of the Wheat Branch of the Department of Agriculture, who ascertained by measurement the areas stripped for grain by the competitors, and computed the yields from the amount of wheat delivered to the merchants and that kept on the farm.

The trophies were presented for competition by the Cuming Smith–Mt. Lyell Farmers Fertilisers Co., Ltd. The main trophy is the Challenge Shield upon which is inscribed, permanently, the names of the winning society and the names of the farmers comprising the team entered, and also the names of the Districts and the personnel of the teams which have won it in any particular year during the period of the competition. In addition to the shield, the donors presented each member of a winning team with a small replica of the shield, on which is inscribed the name of the District winning the yearly competition, and each member of the team.

For the first year of the competition (1928–29) seventeen teams complied with the conditions. The first three places were filled as follows :—

1. Yandanooka	26 bus.	17 lbs.
2. Gnowangerup	26 ,,	14 ,,
3. Borden	24 ,,	29 ,,

The total area harvested by the 17 teams (85 farmers), was 40,978 acres, which yielded 676,457 bushels, an average acre yield of 16 bushels 30lbs. The highest individual average yield for this year was that of Mr. P. C. Neville, of Yandanooka, who averaged 31 bushels 38lbs. from 313 acres. This yield created a new State official record, the previous record being 26 bushels 56lbs., established in 1925, by Mr. T. Richards, South Caroling.

In the second year of the competition (1929–30), twelve teams complied with the conditions. The three leading teams were as follows :—

1. Gnowangerup	30 bus.	34 lbs.
2. Borden	25 ,,	39 ,,
3. Yandanooka	24 ,,	54 ,,

The total area harvested by the twelve teams (60 farmers) was 32,741 acres for a gross yield of 611,192 bushels, an average acre yield of 18 bushels 40lbs. Mr. J. McDonald, of Gnowangerup, produced the highest average yield in 1929–30, averaging 36 bushels 41 lbs. from 279 acres. This eclipsed the official State record created last year by Mr. P. C. Neville of Yandanooka.

In the final year of the competition eight teams competed, the three leading competitors being :—

1. Bruce Rock .... 26 bus. 41 lbs.
2. Yandanooka .... 24 ,, 7 ,,
3. Nungarin .... 22 ,, 23 ,,

The total area harvested by the eight teams was 16,779 acres for a gross yield of 366,400 bushels 32 lbs., an average acre yield of 21 bushels 50 lbs. The highest individual average yield per acre in the final year of the competition was produced by Messrs. Pascoe Bros., of Bruce Rock, who averaged 31 bushels 54 lbs. from 299 acres.

The detailed results for 1930–31, the final year of the competition, are as follows : —

District.	Members of Team.	Acreage.	Yield.			
			Gross.		Average per acre.	
			bus.	lbs.	bus.	lbs.
Bruce Rock	Pascoe Bros.	299	9,537	...	31	54
	Strange, P. A.	432	11,856	55	27	27
	Craigie, J.	563	14,632	46	25	59
	Smith, C. & A. H.	1,383	35,890	38	25	57
	Tibbs, J. A.	345	8,699	53	25	13
		3,022	80,617	12	26	41
Yandanooka	Eckermann, H. W	246	7,335	31	29	49
	Saunders, W.	238	6,351	3	26	41
	Quartermaine, R.	230	5,377	44	23	23
	Fyfe, G. D.	200	4,538	45	22	42
	Downes, C. W.	264	4,804	12	18	12
		1,178	28,407	15	24	7
Nungarin	Williams, F. A.	337	9,126	50	27	5
	McDonnell & Hinkley	790	19,324	23	24	28
	Mannel, C. J.	248	6,043	5	24	22
	Waterhouse, H. H.	514	11,061	33	21	31
	Creagh, Bros.	1,172	22,992	45	19	37
		3,061	68,548	36	22	23
Gnowangerup	Stewart, W. B.	289	6,578	26	22	46
	White, R. H.	245	5,535	8	22	36
	Lohoar, W.	262	5,866	40	22	23
	McDonald, J.	262	5,577	42	21	17
	Stewart, T. D.	209	3,751	15	17	57
		1,267	27,309	11	21	33
Tammin	Nottage, R. B.	310	7,812	28	25	12
	Mann, J. W.	543	11,804	29	21	44
	Hocking, H. R.	395	8,506	49	21	32
	Uphill, G.	1,037	20,197	31	19	29
	Mackin, C. C.	855	15,154	44	17	43
		3,140	63,476	1	20	13
Three Springs	Stokes, N. E.	268	7,137	0	26	38
	Carter, R. & Sons	318	7,412	11	23	19
	Glyde, K. S.	204	3,770	0	18	29
	Bastian, A.	536	9,668	0	18	2
	Hunter, J.	475	7,977	0	16	48
		1,801	35,964	11	19	58
Moulyinning	Cohen & Gibbs	230	5,458	9	23	44
	Clark Bros	379	8,275	36	21	50
	Mott, H.	222	4,238	0	19	5
	Carwardine, F.	383	7,056	30	18	25
	Mott, C.	458	7,505	56	16	23
		1,672	32,534	11	19	28
Borden	Murray, W. W.	465	9,860	14	21	12
	McLennan's Est.	423	8,369	12	19	47
	West, F. C.	249	4,301	9	17	16
	Moir, J. A.	228	3,477	55	15	15
	Pinney, G.	273	3,535	25	12	57
		1,638	29,543	55	18	2

The progressive results of the competition are tabulated below. This show the results for each of the three years, and the district teams' averages.

District.	Members of Team.	Acreage.	Yield. Gross.		Average per acre.	
			bus.	lbs.	bus.	lbs.
Gnowangerup, 1930 ...	Stewart, W. B.	289	6,578	26	22	46
	White, R. H.	245	5,535	8	22	36
	Lohoar, W.	262	5,866	40	22	23
	McDonald, J.	262	5,577	42	21	17
	Stewart, T. D.	209	3,751	15	17	57
		1,267	27,309	11	21	33
1929 ...	McDonald, J.	279	10,233	56	36	41
	Willard & Williard	249	7,551	24	30	20
	Formby & Co., Ltd.	227	6,652	24	29	18
	Lohoar, W.	292	8,376	0	28	41
	Mouritz, E. A.	200	5,303	0	26	31
		1,247	38,116	44	30	34
1928 ...	Davis, N. P.	337	9,952	0	29	32
	Parkinson, A. W.	243	7,123	0	29	19
	Garnett, J.	200	5,482	0	27	25
	Johnson, A.	332	8,093	0	24	23
	Chambers, E.	292	6,177	0	21	19
		1,404	36,827	0	26	14

Gross Yield, 3 years—102,252 bus. 55 lbs.
Gross Acreage, 3 years—3,918 acres.
Final average per acre over 3 years—26 bus. 6 lbs.

Yandanooka, 1930 ...	Eckermann, H. W.	246	7,335	31	29	49
	Saunders, W.	238	6,351	3	26	41
	Quartermaine, R.	230	5,377	44	23	23
	Fyfe, G. D.	200	4,538	45	22	42
	Downes, C. W.	264	4,804	12	18	12
		1,178	28,407	15	24	7
1929 ...	Eckermann, H. W.	257	7,214	52	28	4
	Saunders, W. S.	241	6,735	8	27	57
	Quartermaine, R.	229	5,616	0	24	31
	Smith, H. A.	545	12,760	4	23	25
	Browning, H.	222	4,862	9	21	54
		1,494	37,188	13	24	53
1928 ...	Neville, P. C.	313	9,900	0	31	38
	Saunders, W. S.	238	6,760	0	28	24
	Eckermann, H. W.	255	6,452	0	25	18
	Duff, T.	302	7,176	0	23	46
	Wick, E. F.	291	6,490	0	22	18
		1,399	36,778	0	26	17

Gross Yield, 3 years—102,373 bus. 28 lbs.
Gross acreage, 3 years—4,071 acres.
Final average per acre over 3 years—25 bus. 9 lbs.

Borden, 1930	Murray, W. W.	465	9,860	14	21	12
	McLennan's Est.	423	8,369	12	19	47
	West, F. C.	249	4,301	9	17	16
	Moir, J. A.	228	3,477	55	15	15
	Pinney, G.	273	3,535	25	12	57
		1,638	29,543	55	18	2
1929	Booroondara Grazing Co., Ltd. ...	216	6,000	0	27	46
	Moir, C. C.	220	5,776	28	26	15
	Stone, J. D.	584	15,217	8	26	3
	Murray, W. W.	423	10,772	32	25	28
	Stone, S. G.	231	5,177	0	22	25
		1,674	42,943	8	25	39
1928	Milne, M.	257	6,978	0	27	9
	Bungey, R.	332	8,200	0	24	42
	Murray, W.	201	4,900	0	24	23
	McLennan, W., Estate of ...	215	5,220	0	24	17
	Moir, J.	200	4,197	0	20	59
		1,205	29,495	0	24	29

Gross Yield, 3 years—101,982 bus. 3 lbs.
Gross acreage, 3 years—4,517 acres.
Final average per acre oper 3 years—22 bus. 35 lbs.

District.	Members of Team.	Acreage.	Yield. Gross. bus.	lbs.	Average per acre. bus.	lbs.
Bruce Rock, 1930 ...	Pascoe Bros.	299	7,537	0	31	54
	Strange, P. A.	432	11,856	55	27	27
	Craigie, J.	563	14,632	46	25	59
	Smith, C. & A. H.	1,383	35,890	38	25	57
	Tibbs, J. A.	345	8,699	53	25	13
		3,022	80,617	12	26	41
1929 ...	Smith, C. & Sons	2,765	56,972	0	20	36
	Ellis, M. P. & E. G.	296	5,538	29	18	42
	Garret, G.	697	12,973	28	18	37
	Cusbert, L. C.	559	9,294	44	16	38
	Muntz, J. N. & Son	379	5,839	36	15	24
		4,696	90,618	17	19	18
1928 ...	Mann, R.	543	9,620	0	17	43
	Haggerty, H. J.	333	5,724	0	17	11
	Stone, S. B.	540	7,170	0	16	59
	Abraham, J. M.	665	10,165	0	15	17
	Tibbs, J. A.	318	4,821	0	15	10
		2,399	39,500	0	16	28

Gross yield, 3 years—210,735 bus. 29 lbs.
Gross acreage, 3 years—10,117 acres.
Final average per acre over 3 years—20 bus. 50 lbs.

Three Springs, 1930 ...	Stokes, N. F	268	7,137	0	26	38
	Carter, R. & Sons	318	7,412	11	23	19
	Glyde, K. S.	204	3,770	0	18	29
	Bastian, A.	536	9,668	0	18	2
	Hunter, J.	475	7,977	0	16	48
		1,801	35,964	11	19	58
1929 ...	Bastian, A.	333	8,494	0	25	30
	Carter, R. & Sons	277	6,997	0	25	16
	Thomas, C. F. & Sons	526	11,512	12	21	53
	Cousins, A. H.	700	14,204	0	20	17
	Strutton, A. R.	546	10,216	3	18	43
		2,382	51,423	15	21	35
1928 ...	Bastian, A.	283	6,953	0	24	34
	Glyde, K. S.	328	6,806	0	20	45
	Thomas & Sons	567	11,692	0	20	37
	Carter, R. & Sons	353	6,297	0	17	50
	Broad, A. F.	605	9,524	0	15	45
		2,136	41,272	0	19	19

Gross Yield, 3 years—128,659 bus. 26 lbs.
Gross acreage, 3 years—6,319 acres.
Final average per acre over 3 years—20 bus. 22 lbs.

Moulyinning, 1930 ...	Cohen & Gibbs	230	5,458	9	23	44
	Clark Bros.	379	8,275	36	21	50
	Mott, H.	222	4,238	0	19	5
	Carwardine, F.	383	7,056	30	18	25
	Mott, C.	458	7,505	56	16	23
		1,672	32,534	11	19	28
1929 ...	Wilson, A. F.	550	12,678	23	23	3
	Mott, C.	249	5,248	0	21	17
	Mott, H.	222	4,619	0	20	48
	Clark Bros.	315	6,014	54	19	6
	Hornsby & Sons	344	6,504	20	18	54
		1,680	35,064	37	20	52
1928 ...	Wilson, A. F.	415	8,715	0	21	0
	Hornsby & Sons	250	5,134	0	20	32
	Clark Bros.	289	4,767	0	16	30
	Mott, C.	461	7,517	0	16	19
	Elder, A.	429	5,960	0	13	54
		1,844	32,093	0	17	24

Gross Yield, 3 years—99,691 bus. 48 lbs.
Gross acreage, 3 years—5,196 acres.
Final average per acre over 3 years—19 bus. 11 lbs.

District.	Members of Team.	Acreage.	Yield. Gross.		Average per acre.	
			bus.	lbs.	bus.	lbs.
Tammin, 1930	Nottage, E. B.	310	7,812	28	25	12
	Mann, J. W.	543	11,804	29	21	44
	Hocking, H. R.	395	8,506	49	21	32
	Uphill, G.	1,037	20,197	31	19	29
	Mackin, C. C.	855	15,154	44	17	43
		3,140	63,476	1	20	13
1929	Nottage, E. B.	249	6,029	0	24	13
	Hocking, H. R.	392	8,041	25	20	31
	Mackin, C. C.	558	10,454	0	18	44
	Uphill, G.	902	16,157	25	17	55
	Mann, J. W.	609	10,755	0	17	40
		2,710	51,436	50	18	59
1928	Uphill, G.	963	16,644	0	17	17
	Mann, J. W.	378	7,306	0	19	19
	Thomson, M.	621	9,994	0	16	6
	Mackin, C. C.	829	11,560	0	13	57
	Hocking, A. S.	385	5,718	0	14	51
		3,176	51,222	0	16	8
	Gross Yield, 3 years —166,134 bus. 51 lbs. Gross acreage, 3 years—9,026 acres. Final average per acre over 3 years—18 bus. 24 lbs.					
Nungarin, 1930	Williams, F. A.	337	9,126	50	27	5
	McDonnell & Hinkley	790	19,324	23	24	28
	Manuel, C. J.	248	6,043	5	24	22
	Waterhouse, H. H.	514	11,061	33	21	31
	Creagh, Bros.	1,172	22,992	45	19	37
		3,061	68,548	36	22	23
1929	Johnston, J. H.	575	8,531	8	14	50
	Creagh Bros.	1,060	15,697	0	14	49
	Fitzpatrick, R. C.	783	11,200	48	14	18
	Dawe, S. D.	826	11,669	26	14	8
	Reynolds, A. G.	1,335	13,700	54	10	16
		4,579	60,799	16	13	17
1928	Williams, F. A.	483	8,042	0	16	39
	Dawe, A. F. (Estate of)	290	4,738	0	16	20
	Creagh, Bros.	916	14,141	0	15	26
	Warner, F. L.	627	8,741	0	13	57
	Payne, H. G.	518	6,113	0	11	48
		2,834	41,775	0	14	44
	Gross Yield, 3 years—170,922 bus. 52 lbs. Gross acreage, 3 years—10,474 acres. Final average per acre over 3 years—16 bus. 20 lbs.					

The shield, therefore, was won by the team nominated by the Gnowangerup District Agricultural Society, which averaged 26 bushels 6 lbs. for the three year period the competition was conducted. Their win was a well sustained effort, being placed second in the first year, first in the second year, and fourth in the final year, their average being 57 lbs. higher than the team which occupied second place, the Yandanooka team, and whose achievement was also a meritorious one.

During the course of the competition the total area harvested by all competitors was 92,498 acres for a total yield of 1,654,050 bushels, an average area yield of 17 bushels 53 lbs. Scattered, as they were, over widely separated portions of the wheat belt, the competitors have demonstrated that higher average yields per acre can be obtained when sound farming methods are adopted.

The keenness of those competitors, who, though realising that they had no chance of winning, still remained in the competition, is indeed very commendable.

FRUIT FLY (*Ceratitis capitata*).

A further series of Trapping or Luring experiments.

By

L. J. NEWMAN, Ento. F.E.S., and B. A. O'CONNOR, B.Sc., Agr.

In continuance of our efforts to discover improved methods of control of this very serious fruit pest, a series of Trapping or Luring Experiments have again been undertaken.

Many experiments along this line had previously been made, which demonstrated that the actions of insects are, to a large extent, directed by the sense of smell rather than that of sight. The sense of smell has been proved to be, for certain substances, remarkably acute. In an attempt to play upon this olfactory susceptibility we have continued our research. This is known as Chemotropism, which in common parlance means a reaction to stimuli of a chemical nature, perceived by the insect through its sense of smell. In the same manner it may be possible to discover some odour which will have a negative chemotropic reaction and thus act as a repellant.

Some of the chemicals tried proved to be absolutely neutral, the flies being neither attracted nor repelled. A fairly large number of weak attractants have been found, but few strong ones.

The discovery of the Pollard and Borax lure, evolved by us, was the first successful trapping medium that was recommended against this fly. This lure held its own until some 15 months ago, when we discovered that the proprietary spray known as "Clensel" gave better results.

In the Clensel we have a considerably more powerful lure. Just what is the particular constituent of this liquid soap that exerts this influence over the fly, has not been determined. It may not be due to any single factor but to a combination of attractive compounds. Having made this discovery, it was decided to test it out against the Pollard and Borax lure. The tests were carried out over a period of 12 months in a suburban garden. The first thing that had to be determined was the most effective and economical strength at which to use Clensel. It might be supposed that the stronger the concentration, the greater the catch of flies, but this is not so. There is a limit to the strength to be used, beyond that there is no advantage; in fact it was proved to be disadvantageous and rendered the treatment uneconomical.

Trials were commenced on the 28th May, 1930, and continued throughout the winter, spring and summer, to the 14th May, 1931. During these luring trials we also tested out the relative values of tins *versus* glass traps.

The lures used were Clensel at strengths of 1 in 20, 30, 40, 50, and 80 parts of water and the Departmental Pollard, Borax and water mixture. Ten tins, and ten glass jars of a capacity of half pint were used, making a total of 20 traps. These were half filled and placed, two of each type, making a total of four in each tree. The lures were renewed every seven days, and the total flies and their sexes in each trap recorded. In the following is given, in tabulated form, the results of the 12 months trials.

Experiment commenced 28th May, 1930—Terminated 14th May, 1931.

Lure.	Males.		Females.		Total.	
	No.	%	No.	%	No.	
Clensel	4,883	29·8	11,514	70·2	16,397	20,453
Pollard and Borax ...	1,066	26·3	2,990	73·7	4,056	

A perusal of this table reveals that the Clensel lure captured 16,397 fruit flies, or roughly four times as many as the Pollard and Borax. Further, it will be seen that the percentage of females is only slightly less than the Pollard and Borax.

Table 2.—TIN *versus* JAR.

——	Males.		Females.		Total.	
	No.	%	No.	%	No.	
Tin	3,636	30·5	8,286	69·5	11,922	20,453
Jar	2,313	26·3	6,218	72·9	8,531	

The results brought about by this test show, taking the year through, that the tin traps yielded some 3,391 more flies than the glass ones. This lead was gained during the height of the fly season (February to April) when luring is less effective as a means of control. It was noted, however, that during the months of July to October the glass traps gave practically as good results. As this is the most important trapping period, we would recommend the use of glass jars in preference to tins for the following reasons :—They do not rust or lose their brightness ; they last a lifetime unless broken ; glass jars are more readily kept clean than tins ; the flies captured can be readily seen by the operators and thus they are stimulated to continue the operation of the traps.

TABLE 3.

In this table is given the monthly capture, percentage of sexes, aggregate percentage of males and females, and total captured in the combined lures.

Month.	Males.		Females.		Total.
	No.	%	No.	%	No.
June	306	15·3	1,693	84·7	1,999
July	14	12·8	95	87·2	109
August	6	30·0	14	70·0	20
September	7	20·6	27	79·4	34
October	7	41·2	10	58·8	17
November	13	41·9	18	58·1	31
December	57	29·4	137	70·6	194
January	396	53·2	349	46·8	745
February	39	47·6	43	52·4	82
March	1,370	28·7	3,396	71·3	4,766
April	2,987	29·8	7,018	70·2	10,005
15th May	747	30·5	1,704	69·5	2,451
Total	5,949	29·1	14,504	70·9	20,453

	No.		%
Total males	5,949	Aggregate	29·1
Total females	14,504	do.	70·9
Total	20,453		

By a study of this table the rapid falling away in the number of flies captured after the month of June is shown. It is not until late November that any great increase in capture is again noted. This has been proved each year that tests of this nature have been made and goes to substantiate our oft-repeated declarations, that this fly is mainly, if not solely, carried over the months of July to November, per medium of over-wintering females.

These flies are attracted to the citrus trees which offer good shelter from the rain, wind and cold. The flies feed upon honey dew given off by Scales and Aphides, juice of split citrus fruits, etc. It is always important in dealing with an insect pest to determine how and where it spends the winter, because it can often be fought more efficiently during this season than during the period of its summer activity. There is definite evidence that the fruit fly, provided it can obtain the necessary shelter and food supply, can withstand considerable periods of cold and wet. We have failed to find any native fruits suited to the propagation of this fly, hence the trouble is confined to our orchards. This renders the control considerably easier than in those countries where suitable native fruits exist outside the orchards.

SUMMARY.

Clensel at a strength of 1 part to 30 parts of water is recommended as the luring agent. It attracts both sexes of the fruit fly. Renew lure every seven days in summer or whenever traps go dry. Renew in cool weather every 10 to 12 days.

Glass jars as traps are advised, especially during the months of July to December.

The most effective time to lure is between July and December. One female fly captured during this period is worth thousands caught during the peak of the season.

If fruit is present on trees, hang traps in proximity to same.

Hang traps in sunny aspect from April to October. During summer, hang in shady position.

The minimum number of traps per tree is two. As many more may be used as the operator can attend to.

The trapping or luring method is advised for small orchards up to 200 trees. In larger orchards they may be used as indicators of the presence of the fly, when the foliage bait should be at once applied once a week.

Trapping appeals to most people (this is particularly so when glass jars are used) because it gives great satisfaction to the operator in that he or she is able to see the capture.

The most vulnerable period to attack this fly is between the months of July to December. Unfortunately, most growers take little or no interest in the pest until it again appears in plague form.

In view of the known facts concerning the fruit fly in this State, it behoves all growers, large or small, to continue the warfare throughout the whole year, whenever weather conditions will permit. The reduction brought about by the destruction of the winter and spring flies is most important in any control of this pest.

The captures may be few, but it must be remembered that these are the progenitors of the myriads which appear in the mid and late summer.

Once again it must be repeated that orchard sanitation must be strictly practised, which means the keeping clean of all litter and rubbish, and the daily picking up and boiling of infested fruits.

CHEMICAL WEED KILLERS.

PRELIMINARY REPORT ON THE USE OF CALCIUM AND SODIUM CHLORATES AS WEED KILLERS.

H. G. Elliott, Dip. Agric., Assistant Plant Pathologist, and
G. R. W. Meadly, B.Sc., Agricultural Adviser.

During recent years chlorates have come under notice as weed killers, and various experiments have been carried out in different parts of the world in order to ascertain the best strengths to use and methods to employ in weed eradication. One of the first trials in America demonstrated that Johnson Grass can be successfully controlled by the application of a 10 per cent. solution of sodium chlorate in spring, followed by a further spray in summer, to kill any plants which may have survived the first application.

EXPERIMENTS CARRIED OUT BY THE DEPARTMENT.

1. *Commercial calcium chlorate.*—On 20th January small areas in the experimental plot at Perth were sprayed with 5 per cent., 10 per cent., and 15 per cent. solutions of commercial calcium chlorate, using a fine spray, and applying until the foliage of the plants was completely covered. The main plants present were:—

Anagallis spp. (Pimpernel).
Chenopodium ambrosioides (Ant Weed)
Cynodon dactylon (Couch Grass).
Cyperus spp. (Nut Grass, etc.).
Digitaria marginata (Summer Grass).
Echinochloa colona (Barnyard Millet).
Medicago denticulata (Burr Trefoil).
Melilotus indica (King Island Melilot).
Nasturtium officinale (Water Cress).
Paspalum dilatatum (Paspalum).
Plantago major (Rib Grass).
Polygonum aviculare (Wire Weed).
Polypogon monspeliensis (Beard Grass).
Portulaca oleracea (Purslane).
Ricinus communis (Castor Oil).
Rumex spp. (Docks).
Solanum nigrum (Nitghtshade).
Sonchus oleracea (Milk Thistle).
Stellaria media (Chickweed).
Villarsia spp. (Wild Violet).

Although at the end of the first day after spraying several plants, particularly Nightshade and Docks, were showing decided signs of wilting, with the exception of the 15 per cent. portion the majority of the plants recovered. The 5 per cent. was of little or no use; the 10 per cent. produced a drying effect, killing a few of the less hardy plants, whereas the 15 per cent. apparently destroyed a number of plants, the young Nut Grass in particular being affected.

Further experiments were carried out with 15 per cent. solution on Blackberries at Jarrahdale. Although at the end of the first week the leaves were considerably shrivelled, the plants soon recovered and produced normal shoots.

From the results obtained it is evident that commercial calcium chlorate is not particularly satisfactory as a weed killer, for even when using a 15 per cent. solution the results obtained were not impressive.

2. *Commercial sodium chlorate.*—A corresponding series of experiments was carried out using varying concentrations of sodium chlorate. On the experimental plot it was found that a 5 per cent. solution, in general, was sufficient to kill the Castor Oil plants. With this strength some of the Nightshade recovered, but with 10 per cent. and 15 per cent. solutions the Nightshade, Nut Grass, and majority of other weeds were apparently killed. The 15 per cent. produced more marked results than the 10 per cent. and a greater drying effect was noted.

Five per cent., 10 per cent., and 15 per cent. solutions were used in spraying Blackberries at Jarrahdale. The 15 per cent. solution was first used (5th February) and in a fortnight all the leaves were dried and the branches were also wilting back considerably. Five weeks after application a very limited number of green leaves were evident (12th March), and the plants were then burned.

Three weeks after spraying with 5 per cent. and 10 per cent. solutions the plants were wilted back, apparently to the same extent as with the stronger solution, and no new shoots were evident. This effectiveness of the weaker solutions may be due to the slower wilting produced in the leaves and consequently the increased opportunity to take in more of the solution before plasmolysis occurs.

As far as can be ascertained at this stage of the experiments, sodium chlorate should be a very effective spray for eradicating most weeds, since at present it appears that two of our most persistent weeds, Nut Grass and Blackberry, may be controlled by means of it.

PROPOSED EXPERIMENTS.

1. Blackberry (*Rubus fruticosus*). Further experiments will be carried out on this during the coming season.
2. Cape Tulip (*Homeria collina* and *H. miniata*).
3. Guildford Grass (*Romulea rosea*).
4. Geraldton Carnation Weed (*Euphorbia terracina*).
5. Cape Thistle (*Berkheya carduoides*).

Trials will be conducted with various concentrations of sodium chlorate at suitable times.

METHOD OF APPLICATION.

It has been demonstrated elsewhere that sodium and calcium chlorates can be used in solution or in the crystal form. It is much more economical to apply these salts in solution, since the quantity of material use by this method is only about one-sixth of that used in the dry state.

TIME OF APPLICATION.

It is generally accepted that the most suitable time to apply the sprays is when the plants are in full bloom, the application being made in the sunlight. In contrast with most other weed killers, chlorates do not usually show immediate results—branches gradually dying back and finally the whole plant succumbing.

Spraying or treatment should never be attempted in the winter, and cultivation prior to application of chlorates is not recommended if best results are required.

The effectiveness of the treatment increases as the plants approach maturity. This may be attributed to the fibrous nature of the plants as they near maturity, and the ease of dissemination of the chemical through the rooting system.

Treatments are considered more effective if the water table is more or less stationary or slightly lowering at the time of application.

STRENGTH OF SOLUTION.

The strength of the solution varies with the type of weed and the stage of growth when applied. A 10 per cent. solution (1 lb. crystal to 1 gallon water) is generally recommended, but some of the softer types of weeds may be destroyed by a 2½ per cent. solution. About 100 gallons of the spray per acre have been found sufficient in most cases. When applying crystals instead of spraying, approximately 640 lbs. per acre are required.

SPRAYING APPARATUS.

For general use the knapsack sprayer is the most serviceable. This should be fitted with a trigger spray to prevent waste. The nozzle should be very fine so as to enable the whole leaf surface to be covered without undue waste.

CAUTION.

The apparatus in which sodium chlorate has been used must be thoroughly cleaned by rinsing several times in clean water. Clothing, straw, or chaff moistened with the solution and permitted to dry may be ignited by friction or a spark. The material should be handled very carefully, and the solution should not be prepared in barns or sheds.

POISONOUS PROPERTIES.

In America it has been shown that sodium, magnesium and calcium chlorates are non-poisonous to man, farm animals or the soil. In New Zealand it is stated that both sodium and calcium chlorate are safe as far as stock are concerned and spraying may be done while the paddocks are being grazed. During the spraying of Blackberries at Jarrahdale, cattle were grazing in the same paddocks and experienced no ill effects.

DANGEROUS PROPERTIES.

As chlorates are easily inflammable when dry, users are advised to thoroughly wash clothing that may become saturated with the solution during spraying operations. Sodium chlorate, while quite safe to handle by itself, forms explosive mixtures with a number of other substances such as strong acids, sulphur and sugar. Always use alone either in the crystal form or in solution.

Our thanks are due to Messrs. Cuming Smith-Mt. Lyell Farmers' Fertilisers, Ltd., and to Messrs. F. H. Faulding and Co., Ltd., for supplying materials used.

PRODUCERS' MARKETS REPORT.

Producers' Markets Co-operative Limited Report for the three months ended 15th May, 1931:—

Fruit.—Supplies during the period came forward freely, and all prime varieties sold to a good demand. New Season Apples forward in February realised good values, and have since increased in volume and sold at fair values until April, At this point, large consignments of Rejects and Culls came forward to make it impossible to realise fair values; at the same time all prime coloured 2½in. and 2¾in. realised satisfactory values. Oranges: Valencias were forward in volume early and the market was very unsettled until early in March the demand increased and values improved and remained selling at satisfactory prices for f.a.q. to prime.

New Season Navels came forward on 1st April, and were sold to a fair demand. The majority were not matured and played a big part in retarding values, and towards the end of this period they came forward in volume and values eased considerably. Pears: Only a moderate supply, forward early; the bulk of the Bartletts were marketed in March, and the demand was unsettled throughout for f.a.q. to prime, always in demand. Other varieties: the crops were light, the only prime were in demand. Lemons were forward in volume throughout, with fair values being maintained. Early Peaches were forward in fair consignments, and eased at the end of March; fair values were maintained throughout. Plums: good supplies forward in February, and values were firm for all prime large varieties. The President always held pride of place, realising up to 23s. 6d. Prime Nectarines, large and coloured, realised good prices to 17s. 3d. for three-quarter bushel. A good quantity of small and large green forward, which only met a medium demand. Early in February Grapes were forward in volume, with supplies about the same as the period of 1930, and values were in favour of 1931. In February Passion Fruit were well supplied and were sold to a good demand, realising (best) 5s. to 11s. 6d. for three-quarter bushel cases, and easing in volume as from 8th March; values firmed and remained firm. Tomatoes were heavily supplied in February, March and April, with a demand for prime. 1931 supplies were above 1930, and with values in favour of the latter. Good supplies of Figs were forward in three-quarter bushel cases and realised very satisfactory values throughout.

Vegetables.—Supplies during the period have been heavy. Most gardeners report 100 per cent. crops of all lines, pests of all kinds causing very little destruction. Potatoes from the metropolitan area were heavily supplied and values were much below the average, although they were better than last season's return. Country lines have been moderately supplied to a fair demand for prime lines. The new regulations regarding marketing are now in operation, and growers are conforming to them, with very few exceptions. Pumpkin supplies were heavy, and values consistently low; inferior samples hard to quit. Swedes have been short supplied all through the period, and the demand firm; values being high for all prime lines. Cabbage supplies were heavy, and values lower than is usual during this period; country lines were hard to quit at satisfactory rates. Cauliflowers were forward in small quantities early in the quarter, and values were then firm; as supplies increased values receded a little; supplies are now equal to demand and values are firm. Peas have also had a heavy crop, and supplies plentiful; values have maintained a steady level. Beans have been glutted practically all the time and prices below the paying level. Brown Onions maintained a steady value, imported lines affecting the market towards the end of the season. White Onions sold well, high prices being paid for prime lines during the last month. Rock Melons were plentiful to a steady demand for prime varieties, "Rocky Fords" and "Best of All" being the lines principally sought. "Honey Dew" were plentiful this season, but values were not equal to the other varieties mentioned. Cucumbers were plentiful to a good demand, while weather conditions were favourable. Celery has been heavily supplied during the period and values considerably easier than previous seasons; the crop was a bumper one, and the demand easier than usual, being the principal factor in easy values for this line. Rhubarb supplies have been heavy, and values maintained a steady level; bunch lines heavily supplied to a steady demand for most lines, Beetroot being an exception. Lettuce heavily supplied to a weak demand; all lines below prime at glut level; a few prime lines touched fancy prices, but these were rare cases.

Eggs.—During February heavy supplies of eggs were sold to a steady demand, prices ranging from 1s. to 1s. 2d. per dozen for metropolitan new laid hen eggs. This price remained unaltered until the second week in March, when diminishing sup-

plies caused a steady rise in the price which continued until the 1st April, when prices ranged from 1s. 9d. to 1s. 10½d. per dozen. The following week heavier forwardings caused the market to recede, and on the 8th April prices were 1s. 5d. to 1s. 6½d. The increase of supplies was only of a temporary nature, and with the advent of colder weather prices took another sharp rise, which continued until the end of April, when prices ranged from 2s. 3d. to 2s. 6d. per dozen. The effect of these prices on the demand was reflected the following week, when the market dropped to 1s. 10d. to 2s. per dozen, with demand very weak. Since then the demand has been fairly steady at these rates.

Poultry.—During the quarter under review fairly heavy supplies of all lines were marketed to a moderate demand. Prices throughout have shown a decline on the same period last year, in sympathy with practically all lines of produce. During the latter half of February fairly heavy supplies came forward to a steady demand and prime lines realised: Cockerels, 6s. 6d. to 8s. 6d.; Hens, 6s. to 8s.; Muscovy Drakes, 6s. 6d. to 8s. 3d. Turkeys were short supplied, and quality poor. Good prime lines met with a keen demand. March brought an increase in supplies, the demand being steady, and values showed little alteration. Heavy supplies were maintained during April, and the demand also improved. Prices were: Cockerels, 8s. to 10s.; Hens, 6s. to 8s.; Muscovy Drakes, 7s. to 9s. Very few good quality turkeys were offered. Supplies during May have been short, but as the demand has been weak, practically no alteration in price has taken place.

Carcase Meat.—Pork and veal were lightly supplied during February and March, and to a good steady demand. Beef supplies were moderate. Lamb and Mutton were heavily supplied, and values steady. April opened with light supplies of all lines offering, with prime Lamb and Mutton in keen demand, but medium quality was hard to quit. Little alteration in values was noticed during the latter part of the month, with the exception that Beef supplies shortened and values improved. At present only medium supplies of Pork and Veal are coming forward to a steady demand. Beef, Lamb and Mutton are well supplied.

Latest Prices.—Prime Pork, 6d. to 6½d.; Medium Pork, 5d. to 5½d.; Veal: prime Calves, 6d. to 6½d.; Medium Calves, 5d. to 5¾d.; Lamb, 4½d. to 5¾d.; Mutton, 4d. to 4¾d.

MARKET REPORT.

Messers. H. J. Wigmore & Co., Ltd., of Wellington Street, Perth, have supplied us with the following information regarding Chaff available for auction at the Metropolitan Chaff and Grain Auction Sales, held in Perth, for the period March to May (inclusive). In all cases the price quoted is for f.a.q. to prime Wheaten Chaff, packed in new bags:—

	Quantity.	Maximum.	Minimum.
	tons.	£ s. d.	£ s. d.
March	925	3 15 0	3 12 6
April	920	3 17 6	3 10 0
May	795	4 5 0	4 0 0

In March and April the market was about on a par with the preceding three months, but it will be noticed that in May prices were rather better. This can be accounted for firstly, by the rather better demand; secondly, by the falling off in

supplies of f.a.q. to prime, farmers having this quality preferring to hold in anticipation of better values. The dry spell experienced in May also had the effect of tightening the market somewhat, but even now that beneficial rains have fallen we do not anticipate any marked decrease in the prices of best quality. Upon going to press the market is firm, f.a.q. to prime being worth from £4 5s. to £4 7s. 6d. per ton, f.a.q. from £3 17s. 6d. to £4 per ton, other qualities lower.

Oaten Chaff.—The same remarks as to Wheaten Chaff apply. The value of prime quality at time of going to press is from £3 15s. to £3 17s. 6d., f.a.q. £3 12s. 6d. per ton.

Oats.—In March the market was lifeless, good heavy feeds selling at from 1s. 5d. to 1s. 6d. per bushel; April showed some improvement, 1s. 9d. to 2s. 1d. per bushel being obtainable for best quality. The market in May was steady at April rates, and at time of going to press the market is firm at from 1s. 11d. to 2s. per bushel for good heavy feeds.

Wheat.—The market, in sympathy with overseas values, has fluctuated somewhat, at time of writing there being a firm demand at auction for f.a.q. at from 2s. 7½d. to 2s. 8d. per bushel.

Farmers holding surplus seed can be assured of a ready market at the Perth auctions for either truck loads or small parcels.

LIVE STOCK AND MEAT.

For the information of readers of this "Journal," the following particulars have been supplied by Messrs. Elder, Smith, and Coy., Ltd., Perth.

COMPARATIVE FIGURES OF STOCK SOLD AT METROPOLITAN FAT STOCK MARKETS, FOR MONTHS OF MARCH, APRIL AND MAY, 1931.

	March.				April.					May.			
	4th.	11th.	18th.	25th.	1st.	8th.	15th.	22nd.	29th.	6th.	13th.	20th.	27th.
Sheep	10,770	9,742	9,903	10,018	9,415	9,959	10,661	9,951	8,811*	7,122	9,753	8,731	12,614
Cattle	518	583	624	685	530	534	650	529	567	620	565	767	627
Pigs	1,000	1,393	1,393	1,409	1,730	1,207	1,468	1,221	1,177	919	1,116	1,004	1,255

COMPARATIVE VALUES PER POUND.

	March.				April.					May.			
	4th.	11th.	18th.	25th.	1st.	8th.	15th.	22nd.	29th.	6th.	13th.	20th.	27th.
	d.	d	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
Mutton ...	3	3	3	3½	3¾	3¾	4	4	4¼	5¼	5½	6½	5½
Beef	6½	5¾	5½	5	4¾	4¾	4	4¼	4	3¾	3¼	3	4¼
Pork	6½	6½	6¾	6¾	6¾	6¾	6¾	6¾	6¾	7	7	7½	7½
Bacon	5½	5½	5½	5½	5½	5½	5	5½	5½	5¼	5¼	5¼	5¼

METEOROLOGICAL INFORMATION.

STATIONS.	TEMPERATURE.				RAINFALL.		TEMPERATURE.				RAINFALL.		TEMPERATURE.				RAINFALL.	
	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.	Maximum.		Minimum.		For Month.	Average.
	Mean.	Highest.	Mean.	Lowest.			Mean.	Highest.	Mean.	Lowest.			Mean.	Highest.	Mean.	Lowest.		
	MARCH, 1930.						APRIL, 1931.						MAY, 1931.					
					inches.	inches.					inches.	inches.					inches.	
Chapman State Farm	91·2	101·6	62·6	54·7	0·12	0·65	81·5	95·5	57·5	48·2	0·61	0·44	68·9	83·7	49·5	41·3	4·59	2·34
Geraldton	85·6	103·8	63·4	54·2	0·07	0·45	78·8	91·0	69·3	50·8	0·29	0·82	70·2	77·0	53·5	43·4	3·32	2·81
Walebing	88·5	101·0	59·2	50·8	0·17	0·76	78·5	93·0	53·4	37·5	1·39	0·79	65·1	77·1	45·2	36·4	5·65	2·55
Perth	83·5	98·6	62·0	55·1	0·90	0·77	74·4	89·4	57·1	42·3	3·96	1·64	65·7	76·4	49·5	40·0	6·29	5·04
Kalamunda	82·7	95·6	60·0	50·1	0·83	0·85	73·0	89·8	55·2	41·6	3·60	1·89	63·1	74·8	47·8	41·8	7·05	6·04
Bunbury	77·9	88·0	56·4	47·2	0·78	1·00	72·3	87·5	52·7	41·0	1·93	1·71	64·5	71·0	46·4	37·0	4·00	5·25
Bridgetown	85·4	101·0	48·9	36·8	0·78	1·05	74·6	92·0	48·3	34·4	2·29	1·71	63·0	74·2	41·9	28·8	4·42	4·63
Albany	72·9	88·0	58·1	48·0	1·08	1·55	69·3	87·0	54·9	43·8	4·02	2·76	61·8	71·0	48·9	39·8	3·75	5·04
Merredin State Farm	86·3	97·2	59·0	47·2	0·04	1·09	74·6	86·4	52·6	40·0	1·91	0·78	61·8	78·6	42·3	31·9	2·18	1·30
Northam	88·0	99·0	59·6	51·0	0·20	0·74	78·1	93·6	53·4	41·0	0·91	0·80	65·8	79·0	44·3	34·0	3·26	2·20
York	87·1	97·0	57·9	48·0	0·14	0·64	76·9	92·0	52·1	40·0	0·73	0·81	65·3	78·0	43·1	31·5	3·59	2·28
Narrogin State Farm	82·7	94·0	53·9	41·6	0·54	0·81	73·6	92·2	49·0	36·4	1·94	0·15	61·3	74·0	41·9	33·0	3·70	2·78
Katanning	81·3	94·2	55·1	45·0	1·24	0·95	72·5	86·8	51·7	37·1	1·28	1·18	60·9	69·3	43·3	33·4	2·65	2·35
Cape Leeuwin ...	73·0	84·5	61·5	54·5	0·23	1·25	69·3	81·2	58·0	49·4	4·36	2·19	62·6	67·8	53·4	45·8	5·69	5·77

WESTERN AUSTRALIA—DEPARTMENT OF AGRICULTURE.

LIST OF BULLETINS AVAILABLE FOR DISTRIBUTION.

No. 5.—*Fruit Drying.* J. F. Moody.
No. 20.—*The Pruning of Fruit Trees.* J. F. Moody. Price 2s. 6d.
No. 24.—*Hints to Stock Breeders* (revised). R. E. Weir.
No. 30.—*Descriptive Account of the Codlin Moth.* L. J. Newman.
No. 37.—*Conference of Producers,* 1910 *and* 1912.
No. 46.—*Fruit Packing and Marketing and Exporting of Fruit.* J. F. Moody and J. Ramage. Price 1s. 6d.
No. 49.—*The Feeding of Horses.* Professor Paterson and G. L. Sutton.
No. 57.—*Vermin Destruction.* A. Crawford.
No. 60.—*The Farmer's Clip.* J. J. Mahood.
No. 68.—*Flaying and Treatment of Hides.* R. E. Weir.
No. 72.—*The Potato: Its Cultivation, Pests and Diseases.* G. N. Lowe, L. J. Newman, D. A. Herbert.
No. 79.—*Sheep on the Wheat Farm and their Management in W.A.* H. McCallum.
No. 83.—*Horticulture and Viticulture.* A. Despeissis. Price 2s.
No. 87.—*Sheep Feeding Experiments: State Farm, Chapman,* 1920. G. L. Sutton and F. Vanzetti.
No. 88.—*Light Land: Conference.* G. L. Sutton.
No. 90.—*Stock Waters: Standard for Composition of.* E. A. Mann.
No. 91.—*Dairy Premises.* P. G. Hampshire.
No. 93.—*The Home Tanning of Sheep and other Skins.* H. Salt.
No. 96.—*Poison Plants of W.A.* D. A. Herbert.
No. 99.—*Australian White.* G. L. Sutton.
No. 101.—*Cotton Cultivation.* G. L. Sutton.
No. 103.—*Kerosene Method for Eradicating Zamia Palm.* G. K. Baron-Hay.
No. 105.—*Pedigree Selection of Seed.* G. L. Sutton.
No. 106.—*The Red Legged Velvet Earth Mite.* L. J. Newman.
No. 109.—*Rape.* G. L. Sutton.
No. 111.—*Standard Wheat Varieties.* G. L. Sutton and F. Vanzetti.
No. 112.—*Automatic Device for Eradication of Stickfast Flea.* G. Allman.
No. 113.—*Picked Pieces: Classification of Clip.*
No. 114.—*Blue Mould on Citrus Fruits.* W. M. Carne.
No. 115.—*The Value of Windmills for Pumping Water in W.A.* A. H. Scott.
No. 116.—*Spotted Wilt of Tomatoes.* W. M. Carne.
No. 117.—*Cream.* P. G. Hampshire.
No. 118.—*Pigs and Pig Raising.* P. G. Hampshire.
No. 122.—*Descriptive Account of the Fruit Fly.* L. J. Newman.
No. 149.—*Lucerne.* G. L. Sutton.
No. 192.—*Root Rot.* A. J. Despeissis.
No. 220.—*Irrigation and Drainage.* A. H. Scott.
No. 221.—*Soudan Grass.* G. L. Sutton.
No. 225.—*Subterranean Clover.* G. K. Baron-Hay.
No. 238.—*The first Australian Studmaster—His Flock.* G. L. Sutton. (Reprint from "Journal.")
No. 239.—*Field Experiments,* 1927—*Chapman.* I. Thomas (Reprint from "Journal.")
No. 241.—*Field Experiments,* 1927—*Merredin.* Langfield (Reprint from "Journal.")
No. 242.—*Field Experiments,* 1927—*Avondale.* Wild and Bailey. (Reprint from "Journal.")
No. 243.—*Successful Codlin Moth Control in W.A.* G. W. Wickens. (Reprint from "Journal.")
No. 244.—*Fruit Fly—Trapping Experiments.* L. J. Newman and G. W. Wickens. (Reprint from "Journal.")
No. 245.—*Leaf Rust of Stone Fruit.* W. M. Carne. (Reprint from "Journal.")
No. 246.—*Field Experiments—Wongan Farm.* I. Thomas. (Reprint from "Journal.")
No. 247.—*Red Clover.* G. K. Baron-Hay, C. A. Gardner, and A. B. Adams. (Reprint from "Journal.")
No. 248.—*Elephant Grass.* G. K. Baron-Hay and C. A. Gardner. (Reprint from "Journal.")
No. 249.—*Phosphate or Phosphoric Acid* G. L. Sutton. (Reprint from "Journal.")
No. 250.—*Sheep—Hand-feeding.* H. McCallum. (Reprint from "Journal.")

No. 251.—*Rutherglen Bug.* J. L. Newman. (Reprint from "Journal.")

No. 252.—*Worms affecting Sheep.* H. W. Bennetts. (Reprint from "Journal.")

No. 253.—*Drooping-Flowered Clover.* H. M. Carne, C. A. Gardner, and G. K. Baron-Hay. (Reprint from "Journal."

No. 254.—*Sorrel.* W. M. Carne, A. B. Adams, and C. A. Gardner. (Reprint from "Journal."

No. 256.—*Climbing Cut-worm or Tomato Moth.* L. J. Newman. (Reprint from "Journal.")

No. 257.—*Beekeeping Notes.* H. Willoughby Lance. (Reprint from "Journal.")

No. 258.—*Pasture Development in the Great Southern Area.* J. T. Armstrong, B.Sc. (Reprint from "Journal.")

No. 259.—*Phosphatic Licks for Stock.* Geo. L. Sutton. (Reprint from "Journal.")

No. 260.—*The Treatment of Bowling Greens, Tennis Courts and Lawns.* P. G. Hampshire. (Reprint from "Journal.")

No. 261.—*Rose Chief of Wollongbar—The value of "Breeding."* P. G. Hampshire. (Reprint from "Journal.")

No. 262.—*The Blow-fly Menace.* H. McCallum. (Reprint from "Journal.")

No. 263.—*Dairy Farm Competition, Harvey District.* G. K. Baron-Hay. (Reprint from "Journal.")

No. 264.—*Alsike Clover.* C. A. Gardner. (Reprint from "Journal.")

No. 265.—*Blue Lupin.* G. L. Sutton. (Reprint from "Journal.")

No. 266.—*The Blackberry Pest.* G. L. Sutton. (Reprint from "Journal.")

No. 267.—*Royal Agricultural Society Crop Competitions.* I. Thomas. (Reprint from "Journal.")

No. 268.—*Soil Alkali.* L. J. H. Teakle (Reprint from "Journal.")

No. 269.—*Cheap Pasture Production.* G. K. Baron-Hay. (Reprint from "Journal.")

No. 270.—*Subterranean Clover Weevil.* L. J. Newman. (Reprint from "Journal.")

No. 271.—*Seaweed as a Fertiliser.* L. J. H. Teakle and L. J. Newman. (Reprint from "Journal.")

No. 272.—*Biological Control of the Silver-Eye.* L. J. Newman. (Reprint from Journal.")

No. 273.—*Subterranean Clover Seed and its Impurities, with a Comparison between Machine-Cleaned Seed and Seed in the Burr.* H. G. Elliott. (Reprint from "Journal.")

No. 274.—*Nut Grass.* C. A. Gardner. (Reprint from "Journal.")

No. 275.—*Bee-keeping Notes. Spring Work and Re-Queening.* H. Willoughby Lance. (Reprint from "Journal.")

No. 276.—*Minerals in Pastures and their relation to Animal Nutrition.* J. B. Orr. Reprinted from "Journal.")

No. 277.—*The Potato Plot.* G. N. Lowe. (Reprint from "Journal.")

No. 278.—*Pear Scab.* G. W. Wickens. (Reprint from "Journal.")

No. 279.—*Curculio Beetle.* A. Flintoff. (Reprint from "Journal.")

No. 280.—*Fruit Thinning.* G. W. Wickens. (Reprint from "Journal.")

No. 281.—*The Need for Lime in Western Australian Agriculture.* Geo. L. Sutton. (Reprint from Journal.")

No. 282.—*The Cost of Feeding Pure Bred Cows under the Australian Official Herd Recording Scheme.* P. G. Hampshire and P. C. Cousins. (Reprint from "Journal.")

No. 283.—*The Eelworm-Gall or Root-Knot Disease.* H. A. Pittman. (Reprint from "Journal.")

No. 284.—*The Common Blue Lupin.* C. A. Gardner and H. G. Elliott. (Reprint from "Journal.")

No. 285.—*Potato Diseases in Western Australia.* H. A. Pittman. (Reprint from "Journal.")

No. 286.—*Honey.* H. Willoughby Lance, Apiculturist.

No. 287.—*Variation in the Weight of Eggs.* W. T. Richardson, Poultry Adviser.

No. 288.—*Pastures. In Areas of Medium Rainfall.* G. K. Baron-Hay, Assistant Superintendent of Dairying.

No. 289.—*The Unsound Economics of the F.A.Q. Standard for Selling Australian Wheat.* Geo. L. Sutton.

No. 290.—*Wax Scale* (*Ceroplastes Ceriferus*, Anderson. L. J. Newman, F.E.S., Entomologist; B. A. O'Connor, B.Sc., Agr., Agricultural Adviser; and H. G. Andrewartha, B.Sc.Agr., Agricultural Adviser.

No. 291.—"*Early Blight*" or "*Leaf Spot*" *and the Macrosporium* "*Storage Disease*" *of Potatoes.* H. A. Pittman, B.Sc.Agr., Plant Pathologist.

No. 292.—*Cultivation of Onions.* E. T. Morgan, Vegetable Inspector.

The following publications may be obtained from the Department of Agriculture, Perth, on application, or will be sent post free to any address in this State on receipt of a remittance for the amount stated:—

The Handbook of Horticulture and Viticulture of Western Australia, by A. Despiessis, M.R.A.C.:

This publication contains valuable information dealing with all commercial fruits grown in Western Australia, including advice on planting, pruning, packing, manuring, fruit-drying, wine-making, insect and fungoid pests and their treatment, etc., and the whole forms a text book which every fruitgrower, whether large or small, should have in his possession. The price originally was 8s. 6d., but to allow of distribution being as wide as possible it has been reduced to 2s.

The Pruning of Fruit Trees, by J. F. Moody, Fruit Industries Commissioner:

This publication contains numerous illustrations, being reproduction of photographs taken in this State, of pruned and unpruned trees, which make the details set out in the letterpress particularly easy to understand. Price 2s. 6d.

Fruit Packing and the Marketing and Exporting of Fruit, by J. F. Moody, Fruit Industries Commissioner, and J. Ramage, Packing Instructor:

This publication contains invaluable information on packing and grading fruit for local and export markets. It is freely illustrated, and no fruit-packing shed should be without a copy. Price 1s. 6d.

By Authority: FRED. WM. SIMPSON, Government Printer, Perth.